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B.S.

ATLANTIC COAST BASIN
MULLICA RIVER, BURLINGTON COUNTY
NEW JERSEY

AD A069592

ATSION LAKE DAM
NJ 00041

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

May, 1979

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National Dam Inspection Act Report
Atsion Lake Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

24 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Atsion Lake Dam in Burlington County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Atsion Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 11 percent of the Probable Maximum Flood would overtop the dam. The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the fact that failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Remove trees and brush on the dam embankment.

(2) Thoroughly inspect and repair the concrete bridge as outlined below:

(a) Drain the lake to an elevation equal to the bottom of the gates.

(b) Sand blast all concrete and pressure grout all major cracks and patch spalls and eroded surfaces.

(c) Apply an epoxy preservative coating to all surfaces.

(3) Repair or replace the timber slide gates.

(4) Fill and compact all eroded surfaces of the embankment and provide suitable ground cover.

(5) Thoroughly inspect the steel sheet piling and take any necessary remedial action. Construct a concrete cap on the upper portion of the sheet piling.

(6) Install riprap at the normal water line along the entire length of the upstream face of the embankment.

c. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Edwin B. Forsythe of the Sixth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-D
Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

Joel Kallaton LTC

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
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Trenton, NJ 08625

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ATSION LAKE DAM (NJ00041)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 December 1978 and 28 January 1979 by Storch Engineering under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Atsion Lake Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 11 percent of the Probable Maximum Flood would overtop the dam. The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the fact that failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Remove trees and brush on the dam embankment.

(2) Thoroughly inspect and repair the concrete bridge as outlined below:

(a) Drain the lake to an elevation equal to the bottom of the gates.

(b) Sand blast all concrete and pressure grout all major cracks and patch spalls and eroded surfaces.

(c) Apply an epoxy preservative coating to all surfaces.

(3) Repair or replace the timber slide gates.

(4) Fill and compact all eroded surfaces of the embankment and provide suitable ground cover.

(5) Thoroughly inspect the steel sheet piling and take any necessary remedial action. Construct a concrete cap on the upper portion of the sheet piling.

(6) Install riprap at the normal water line along the entire length of the upstream face of the embankment.

c. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

APPROVED: Joel Vallabon LTC
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 24 May 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Atsion Lake Dam, I.D. NJ00041
State Located:	New Jersey
County Located:	Burlington
Drainage Basin:	Atlantic Coastal
Stream:	Mullica River
Dates of Inspection:	December 12, 1978 and February 28, 1979

Assessment of General Condition of Dam

Based on visual inspection, available records, past operational performance and Phase I engineering analyses, Atsion Lake Dam is assessed as being in fair overall condition.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge from the spillway and from a low area of the lake shore adjacent to the dam is not sufficient to pass the designated spillway design flood (SDF) without an overtopping of the dam. (The SDF for Atsion Lake Dam is equal to the probable maximum flood.) The spillway together with the low area adjacent to the dam can pass approximately 10 percent of the probable maximum flood. Therefore, the owner should engage a qualified professional engineer soon to perform accurate hydraulic and hydrologic analyses relating to the spillway capacity. Based on the findings of the analyses, remedial measures should be undertaken to correct the inadequate condition of the spillway. The remedial measures should be designed either to 1) prevent overtopping of the dam resulting from a storm equivalent to the SDF or 2) downgrade the downstream hazard potential by removing the three inhabitable structures presently located in the downstream flood plain.

The embankment is free of settlement and appears to be structurally sound. However, trees and brush as well as erosion are present on its surface. These conditions should be repaired in the near future and thereafter maintained. Repairs include the removal of trees and brush, the filling of eroded areas and the establishment of a grass cover.

The timber spillway structure appears to be in good condition. However, the five slide gates evidence some deterioration and should be repaired or replaced in the near future.

The concrete bridge, although appearing structurally sound, contains a significant number of cracks and spalls which should be repaired in the near future by sand blasting, grouting where needed and coating with epoxy.

Steel sheet piling located on the upstream face of embankment on either side of the bridge should be thoroughly inspected in the near future and any necessary remedial action should be taken. A concrete cap should be constructed on the sheet piling to restore the conditions of 1942 at which time the N.J. Highway Department reportedly installed a concrete cap.

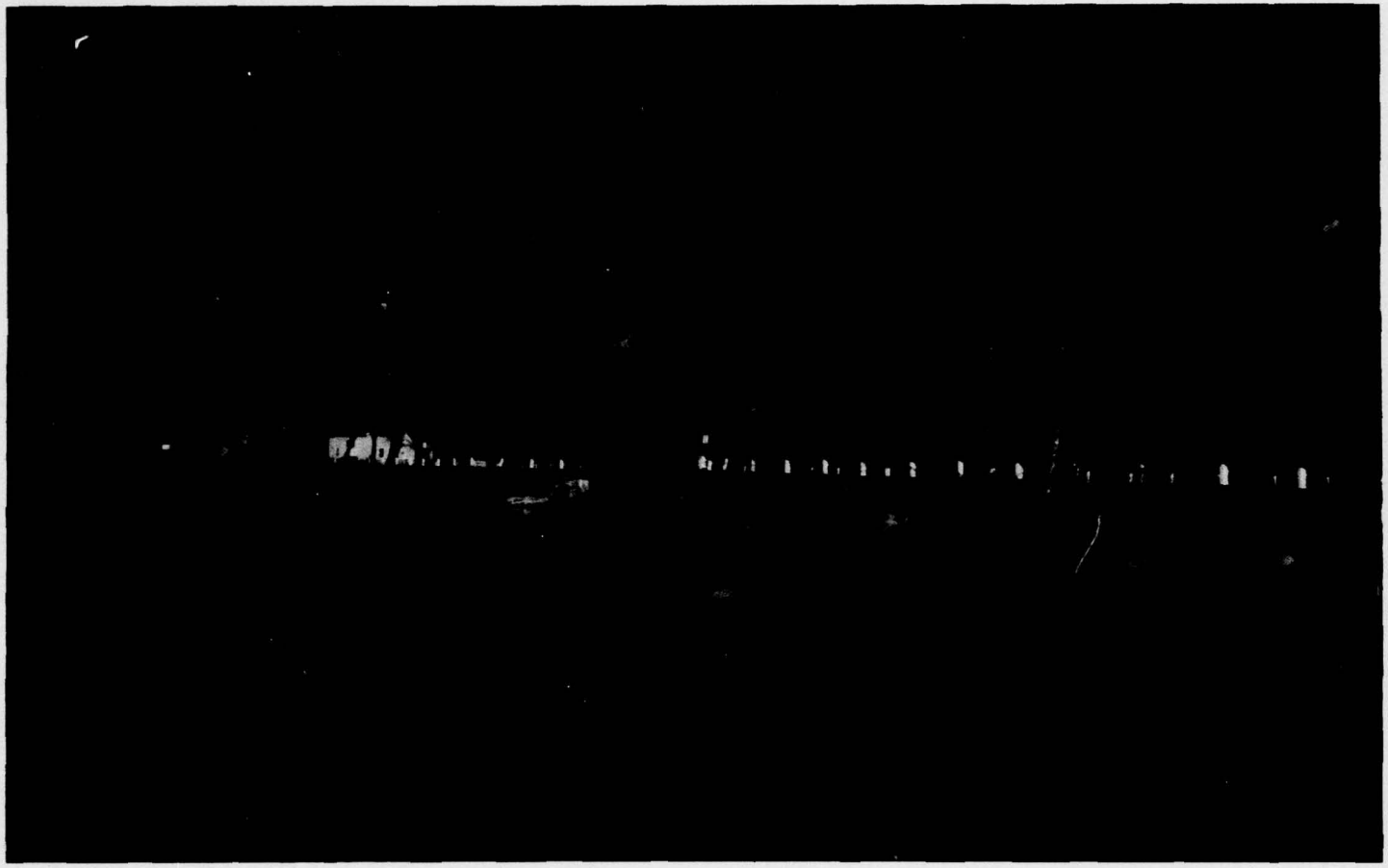
Riprap should be installed along the entire length of the upstream face of embankment in the near future.

The owner should, in the near future, initiate a program of periodic inspection and maintenance for the dam which would include a topographic survey to provide a record of existing conditions. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces and clear the downstream channel.

As part of the maintenance program, the lake should be lowered every five years at which time submerged portions of the dam and appurtenances should be inspected and repaired.

Richard J. McDermott

Richard J. McDermott, P.E.



OVERVIEW - ATSION LAKE DAM

12 DEC. 1978

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 30214. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

ATSION LAKE DAM, I.D. NU00041

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspections of Atsion Lake Dam were made on December 12, 1978 and February 28, 1979. The purpose of the inspections was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description of Dam and Appurtenances

Atsion Lake Dam is an earthfill dam with a spillway consisting of five timber slide gates. Discharge over the gates flows through the dam via a discharge channel formed by the abutments of a concrete bridge. The bridge supports N.J. Highway No. 206 which is located along the crest of dam. A steel sheet piling wall is located along the upstream face of embankment extending approximately 30 feet on each side of the upstream wingwalls of the bridge.

The slide gates of the spillway also serve as outlet works to drain the lake.

The highway located on the dam crest consists of a concrete paved roadway and bituminous paved shoulder. A section of the downstream face of embankment has been covered with bituminous pavement to serve as slope protection.

Having an overall length of 590 feet, the embankment has a top width of 75 feet and upstream and downstream side slopes of 1:1 and 2:1 respectively. Each of the spillway gates has a length of 3.0 feet and height of 8.0 feet. The total spillway weir length is 15 feet.

The upstream wingwalls of the bridge serve as an approach channel for the spillway and the abutments for the bridge serve as a spillway discharge channel having a width of 19.8 feet.

b. Location

Atsion Lake Dam is located in Wharton State Forest in Washington Township, Burlington County, New Jersey. The dam, which lies in a north/south orientation, is located at the east end of Atsion Lake which it impounds. Water released from Atsion Lake passes into Mullica River which flows eastward into the Atlantic Ocean.

c. Size and Hazard Classification

Size and Hazard Classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

	Impoundment	
Category	Storage (Ac-ft)	Height (Ft)
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and $< 50,000$	≥ 40 and < 100
Large	$\geq 50,000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (no permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

The characteristics of Atsion Dam are:

Storage = 1050 acre-feet

Height = 19 feet

Potential Loss of Life: Three inhabitable structures in the flood plain within 1000 feet of dam: one home, one hunting lodge and one summer cottage.

Potential Economic Loss: Three structures listed above. N.J. Highway Route 206 on crest of dam.

Therefore, Atsion Lake Dam is classified as "Intermediate" size and "High" hazard potential.

d. Ownership

Atsion Lake Dam is owned by the New Jersey Department of Transportation (NJDOT), 1035 Parkway Avenue, Trenton, N.J. 08625.

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility.

f. Design and Construction History

The dam reportedly was originally constructed prior to 1800 to impound a mill pond. In 1930, a new spillway and a concrete bridge were constructed by the New Jersey Highway Department, the abutments of the bridge forming a

discharge channel for the spillway. The spillway consisted of five timber gates that could be raised 1.9 feet each. In 1934 a "blow-out of the highway embankment" reportedly occurred behind and beneath the "left upstream wingwall." The New Jersey Highway Department then drove steel sheet piling in front of and approximately two feet from the wingwall.

In 1942, the New Jersey Highway Department reportedly drove additional steel sheet piling and placed a concrete cap over the piling and did considerable grouting.

Also in 1942, the Wharton Estate installed new gates which could be lifted 8 feet. In 1944, the New Jersey Highway Department installed lifting mechanisms on the gates.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the New Jersey Department of Transportation. There is no fixed schedule of maintenance; repairs are made as the need arises.

Operation of the gates is normally performed by the NJDEP, Division of Parks and Forestry which operates Wharton State Forest. The gates are raised to lower the lake for lake related maintenance and also are raised at times of high water level to attenuate flooding conditions.

1.3 Pertinent Data

a. Drainage Area - 27 square miles

b. Discharge at Damsite

Maximum known flood at damsite	Unknown
Outlet works at pool elevation	162 c.f.s.
Diversion tunnel low pool outlet at pool elevation	N.A.
Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at top of dam (elev. 50.5)	220 c.f.s.
Ungated spillway capacity at top of dam (elev. 50.5)	N.A.
Lake overflow (north shore)	225 c.f.s.
Total spillway capacity at top of dam elev. (50.5)	445 c.f.s.

c. Elevation (Feet above MSL)

Top of Dam	Varies:50.5 to 51.7
Maximum pool-design surcharge	52.2
Full flood control pool	N.A.
Recreation pool	48±
Spillway crest	47.4
Upstream portal invert diversion tunnel	N.A.
Stream bed at centerline of dam	35
Maximum tailwater	42± (Estimated)

d. Reservoir

Length of maximum pool	8,100 feet (estimated)
Length of recreation pool	6,000 feet (scaled)
Length of flood control pool	N.A.

e. Storage (Acre-feet)

Recreation pool	250 acre-feet
Flood control pool	N.A.
Design surcharge (Elev. 52.20)	2725 acre-feet
Top of Dam (Elev. 50.5)	1050 acre-feet

f. Reservoir Surface (Acres)

Top of dam (elev. 50.5)	600 acres (estimated)
Maximum pool (elev.52.20)	950 acres (estimated)
Flood control pool	N.A.
Recreation pool	85 acres
Spillway crest	85 acres

g. Dam

Type	Earthfill
Length	590 feet
Height	19 feet
Side slopes - Upstream	1 horiz. to 1 vert.
- Downstream	2 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Unknown
Cutoff	Steel sheet pile wall upstream side of dam each side of bridge.
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Slide gates.
Length	15 feet
Crest elevation	47.4
Gates	5 Timber Slide Gates 3.0' long
Upstream channel	Conc. wingwalls of bridge
Downstream channel	19.8' wide conc. channel (bridge abutments)

j. Regulating Outlets

Timber slide gates 3.0' long

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original dam could be obtained. However, information generated at the time of the bridge and spillway construction in 1930 is available. Construction drawings prepared by the New Jersey State Highway Department, Division of Bridges in 1929 contain the following:

a. Key map
b. Location map
c. Plan, elevations and section of bridge
d. Details of bridge

In addition, hydraulic cacluations in connection with the subject dam are available. Calculations prepared in 1929 indicated that the gates could discharge 1670 c.f.s. when raised 8.5 feet with freeboard equal to 0.5 feet. In 1941, it was found that the gates could be raised only 1.9 feet. New calculations were then prepared in connection with a design for new gates. The design storm was determined to have peak inflow of 1240 c.f.s. based on the South Jersey curve and gaging at Batso on the Batso River. Hydraulic calculations indicated that the gates must be raised 7.2 feet in order to discharge 1240 c.f.s. "with the roadway awash."

A design report prepared in 1929 by the New Jersey State Water Policy Commission stated that an uncontrolled weir spillway capable of passing the design storm was considered unnecessary and that gates capable of being raised at times of high water level would be adequate.

2.2 Construction

Progress reports were prepared by the New Jersey State Water Policy Commission. The reports were initiated before construction commenced and continued through completion of construction. A final report dated October 7, 1930, indicated that work had been completed in accordance with the approved plans.

2.3 Operation

No records of operation of the dam are available. A limited number of inspection reports for the bridge are contained in the files of the New Jersey Department of Transportation. One inspection report for the dam is contained in the NJDEP file. This inspection report, written in 1968, indicates that the dam and appurtenances were in good condition at that time. The report also indicates that timbers in the spillway structure were rotting at the water line but that replacement was not required at that time.

2.4 Evaluation

a. Availability

Available engineering information is limited to that which is on file at the NJDEP and NJDOT. The NJDEP file contains copies of plans calculations, reports, correspondence, photographs and inspection reports. The file is available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N.J.

b. Adequacy

The available information forms a fairly complete description of the subject dam and is considered to be of significant assistance in the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

Most information that could be verified is considered to be valid within a reasonable allowance for error. Hydrologic computations in connection with design flood magnitude are considered invalid in relation to criteria recently developed by the Corps of Engineers. Data found in the NJDEP file at variance with the findings of this inspection and evaluation are noted in paragraph 7.1.b.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspections of Atsion Lake Dam took place on December 12, 1978 and February 28, 1979 by members of the staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1. The embankment of the dam, appurtenant structures and adjacent areas were examined.
2. The embankment and appurtenant structures were measured and key elevations determined by hand level.
3. The embankment and appurtenant structures and adjacent areas were photographed.
4. A member of the maintenance staff of NJDEP, Division of Parks and Forestry was present to assist in the inspecton.

b. Dam

The embankment appeared to be uniformly aligned horizontally. Vertically, the dam crest varies from a maximum elevation of 51.7 to a minimum elevation of 50.5. The south half of the dam has a level crest at elevation 51.7 while the north half slopes downward from elevation 51.7 at the bridge to elevation 50.5 at the north end. A 1000-foot section of the lake shore located along the north side of the lake adjacent to the north end of dam has a bank with elevation varying from 50.2 to 50.5. Therefore, high water levels will flow over the north bank of the lake before overtopping the dam.

The concrete paved highway located on the dam crest is in good condition. The embankment slopes are grass covered with thick tree growth on the downstream face and a few trees on the upstream face. Minor erosion was observed along the upstream face of embankment while significant erosion was noted along some areas of the downstream face. The erosion on the downstream face has caused pieces of bituminous pavement to break away in one location that had been formerly paved.

Riprap was observed along most of the upstream face of embankment. The riprap appeared to be composed of rocks and debris lacking in durability and therefore was assessed as being unsatisfactory.

Steel sheet piling along the upstream face of embankment on either side of the spillway appeared to be structurally sound but its surfaces are severely rusted.

No evidence of cracking or settling was noted in the dam nor were any animal holes observed.

The generalized soils description of the dam site consists of stratified materials, predominantly silty sand and narrowly graded sand, deposited during the Tertiary period and designated on the Geologic Map of New Jersey prepared by Lewis and Kummel as Kirkwood Sands. Composed on the average of varying percentages of very fine to coarse quartz sand, the Kirkwood Sands are overlain in the area of the lake by recently deposited stratified, swampy alluvium consisting of significant organic material, silt and sand with some clay.

Bedrock is in excess of 100 feet below the ground surface.

c. Appurtenant Structures

The timber framework supporting the lift gates of the spillway appeared to be recently constructed and in good condition. The gates appeared to be somewhat deteriorated and were leaking around their edges and through seams. The operating mechanism reportedly is in good condition. One gate was operated during the inspection. The concrete bridge and wingwalls appeared to be structurally sound, although, several cracks and spalls were observed. Some leaching of cement was observed at cracks and joints. Exposure of the concrete aggregate was noted in areas of water level fluctuations and a large section of concrete had broken off from the south downstream wingwall.

d. Reservoir Area

Atsion Lake is a long and narrow irregularly shaped body of water. The lake has an average width of 600 feet and is in excess of one mile long. A large flat swampy area is located immediately south of the lake.

A few homes are located along the north side of the lake while the south side is predominately wooded and swampy with a public park area at the south east end.

e. Downstream Channel

The spillway discharges into the Mullica River which is a wide shallow winding stream with a very wide swampy flood plain. The downstream area of the dam is located within Wharton State Forest. A large stilling basin is located immediately downstream of the spillway discharge channel.

No significant obstructions were observed in the stilling basin or the stream. A few structures are located in the downstream flood plain three of which, reportedly, are inhabited for all or part of the year. There is a home, a hunting lodge and a summer cottage.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Atsion Lake is regulated by natural discharge over the slide gates of the spillway and by discharge through the gate openings when they are raised for operational purposes. The gates are raised to lower the lake for maintenance purposes and at times of intense storms to attenuate flood water levels.

The lake reportedly was most recently lowered during the summer of 1978. At that time, two to three days were required to drawdown the lake.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance for the dam and appurtenances which are maintained by the NJDOT. Maintenance is performed on an "as-needed" basis. Normal maintenance consists of repairs to the roadway located on the dam crest.

4.3 Maintenance of Operating Facilities

Maintenance of operating facilities such as the timber gate structure is performed on an "as-needed" basis by the NJDOT. Reportedly the most recent maintenance consisted of the replacement of timbers in the spillway structure in the fall of 1978.

4.4 Description of Warning System

Reportedly a warning system is maintained by the Division of Parks and Forestry, NJDEP, which operates Wharton State Forest within which the dam is located. State forest rangers observe lake levels during times of intense flooding and personnel at the Division of Parks and Forestry raise the slide gates to attenuate flood levels.

4.5 Evaluation of Operational Adequacy

Operation of the dam has been successful to the extent that the dam has not been overtopped since the warning system has been operating. The system now in effect appears to be a feasible one with minimal potential for human error. This assessment is based on the fact that personnel responsible for observation and gate operation are public employees stationed near the dam.

The NJDOT maintains records of inspection reports for the bridge, which are limited in number. However, documentation of maintenance performed on the dam apparently is not kept. Maintenance of the dam and appurtenances has been fair. Maintenance that has not been adequately performed is as follows:

1. Trees and brush allowed to grow on embankment.
2. Erosion allowed to develop on embankment.
3. Steel sheet piling allowed to rust.
4. Concrete surfaces of bridge and wingwalls allowed to deteriorate.
5. Timber gates not repaired or replaced.
6. Riprap on upstream face of embankment not replaced.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The intensity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff intensity, called the spillway design flood (SDF), is described in terms of frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams", published by the U. S. Army Corps of Engineers, the SDF for Atsion Lake Dam is equal to the PMF.

The SDF peak inflow calculated for Atsion Lake Dam is 7865 c.f.s. This value is derived from the PMF hydrograph computed by the use of Snyder's coefficients in the HEC-1-DB Flood Hydrograph Computer Program. Detailed hyrologic computations and computer output are contained in Appendix 4.

Discharge capacities for Atsion Lake Dam were computed by considering two points of outflow from the lake: the spillway and the low area along the north shore of the lake adjacent to the dam. The spillway was assumed to have characteristics of a sharp crested weir. The discharge with water level at the dam crest (elev. 50.5) was computed

to be 220 c.f.s. The low area adjacent to the dam was assumed to have characteristics of a broad crested weir with C=2.63. Discharge over the low area with water level at the dam crest (elev. 50.5) was computed to be 225 c.f.s.

A routing of the SDF through Atsion Lake resulted in an overtopping of the dam by a height over the dam crest of 1.7 feet (water level elevation 52.2). For overtopping analysis, the dam crest elevation was assumed to be 50.5 which is the elevation at the north end of the dam. (Note: top of dam was assigned elevation 51.7 on the HEC-1-DB program to facilitate input of data; 51.7 is the dam crest elevation at the south end of the dam.

The wide swampy downstream flood plain together with the unusually long amount of time required for a breach to develop in the dam (topwidth 75 feet) indicates that dam failure resulting from overtopping would not significantly increase the hazard from that which would exist just before overtopping failure.

According to the above analysis, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

The dam reportedly has not been overtopped since the 1940's. However, during intense storms in the past, large areas south of Atsion Lake consisting of flat swampy land have become inundated. On one occasion,

water that outflowed from the lake through the swamp overtopped Route 206 approximately 1300 feet south of the dam. A portion of this area has been regraded recently by filling. However, most of the swampy area remains undisturbed.

c. Visual Observations

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a., a storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 1.7 feet over the dam crest. This overtopping would occur at the north end of the dam where the elevation of the crest is lowest. Further computations indicate that the spillway, together with the low area adjacent to the dam, can pass approximately 10 percent of the PMF. In addition, the spillway can pass approximately 4 percent of the PMF without an overtopping of the low area adjacent to the dam.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The embankment appeared, at the time of inspection, to be structurally stable with no evidence of cracks, displacement or differential settlement.

b. Design and Contruction Data

Analysis of structural stability and construction data for the embankment are not available.

c. Operating Records

There are no operating records available for the dam. The water level of Atsion Lake is not monitored in a systematic manner. The only monitoring consists of observations during times of high water in connection with the warning system employed by the NJDEP Division of Parks and Forestry. See paragraph 4.4.

d. Post Construction Changes

Since the bridge and gates were constructed in 1930, the following changes have taken place:

1. Steel sheet piling installed along the upstream face of embankment for approximately 30 feet on either side of the upstream wingwalls of the bridge.

2. Gates replaced in 1941 with gates that can open to a height of 8 feet.
3. Embankment widened. Top width reported in 1930 as 20 feet; measured in 1978 as 75 feet.

e. Seismic Stability

Atsion Lake Dam is located in seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if stable under static loading conditions. Atsion Lake Dam appears to be stable under static loading conditions.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Atsion Lake Dam is considered to be inadequate. The spillway is not able to pass the SDF designated for the dam without an overtopping of the dam, yet failure due to overtopping would not significantly increase the potential for loss of life downstream from that which would exist just before overtopping failure.

The structural integrity of the dam appears to be good based on field inspection. No reported nor written evidence was found that would contradict this assessment.

b. Adequacy of Information

Information sources for this study include: 1) field inspection, 2) plans, correspondence and reports in NJDEP files, 3) USGS quadrangle sheet, 4) aerial photography from Burlington County and 5) consultation with personnel from NJDEP and NJDOT. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some data not available are as follows:

1. Stream and lake elevation gauging records.
2. Description of dam embankment fill materials.
3. Structural design computations and reports.
4. Soils reports.

Data contained in the NJDEP file at variance with the findings of this report are as follows:

1. Slope of downstream face of embankment, reported to be 1:1, was found to be 2:1.
2. Top width of dam, reported to be 20 feet, was found to be 75 feet.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Atsion Lake Dam are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a and appendix 4, the spillway is considered to be inadequate. Therefore, it is recommended that a qualified professional engineer be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to the spillway capacity. The analyses should more accurately determine runoff characteristics of the watershed and should refine the discharge capacity of the spillway and the downstream channel capacity.

Based on the findings of these analyses, the dam and the spillway should be modified to prevent overtopping of the dam resulting from a storm equivalent to the SDF. Some alternative remedial measures include the following, considered individually or in combinations:

1. Replace the spillway with a spillway having a greater effective weir length.

2. Construct an auxiliary spillway to augment the capacity of the existing spillway.

3. Regrade the north end of the dam and the low area along the north shore of the lake to form a level crest with elevation equal to 51.7 and thus eliminate any overtopping of the dam or lake shore below elevation 51.7.

4. Remove the three inhabitable structures from the downstream flood plain of the dam so that the hazard potential can be downgraded from "high" to either "low" or "significant." This may be feasible due to the fact that the downstream area of the dam is owned by the State of New Jersey.

Remedial measures to increase spillway capacity will require hydrologic studies to refine the SDF inflow hydrograph beyond that used for the present Phase I analysis.

In addition to the above, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1. Trees and brush on the dam embankment should be removed. All trees and brush should be cut at the ground surface.

2. The concrete bridge should be thoroughly inspected and repaired as outlined below:

    a. Drain the lake to an elevation equal to the bottom of the gates.
    b. Sand blast all concrete and pressure grout all major cracks and patch spalls and eroded surfaces.
    c. Apply an epoxy preservative coating to all surfaces.

3. Repair or replace the timber slide gates.

4. Fill and compact all eroded surfaces of the embankment and restore a suitable grass cover to all surfaces.

5. Thoroughly inspect the steel sheet piling and take any necessary remedial action. Construct a concrete cap on the upper portion of the sheet piling to restore the conditions of 1942 at which time the N.J. Highway Department reportedly installed a concrete cap.

6. Install riprap at the normal water line along the entire length of the upstream face of embankment.

The implementation of the above measures will require proper detailed design and the obtaining of applicable NJDEP approvals.

b. Maintenance

In the near future, the owner of the dam should initiate a program of periodic inspection and maintenance, the complete records of which to be kept on file and made available to the public. A visual inspection by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, repair the riprap after it is installed on the upstream dam face, fill and sod any eroded surfaces and clear the downstream channel. In addition, the lake should be lowered at least every five years at which time the submerged portions of the dam and spillway should be inspected and repaired.

c. Additional Studies

A detailed topographic survey of the dam, including the area around the dam, should be undertaken in the near future by a qualified licensed land surveyor or professional engineer. The survey map should be related to existing construction drawings and should become part of the permanent record mentioned in paragraph 7.2.b.

PLATES

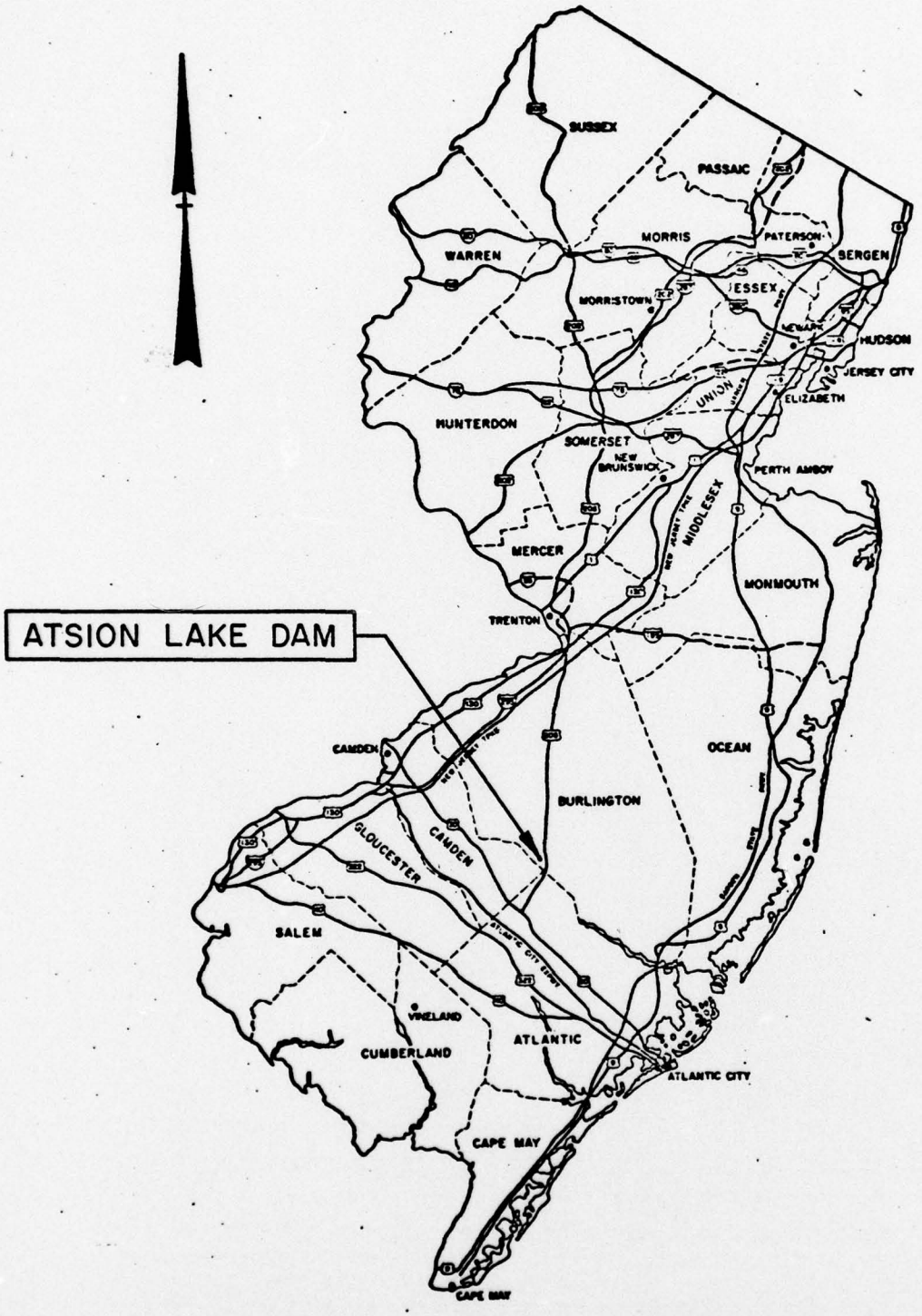


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

KEY MAP

ATSION LAKE DAM

I.D. N.J. 00041	SCALE: NONE
	DATE: MARCH, 1979

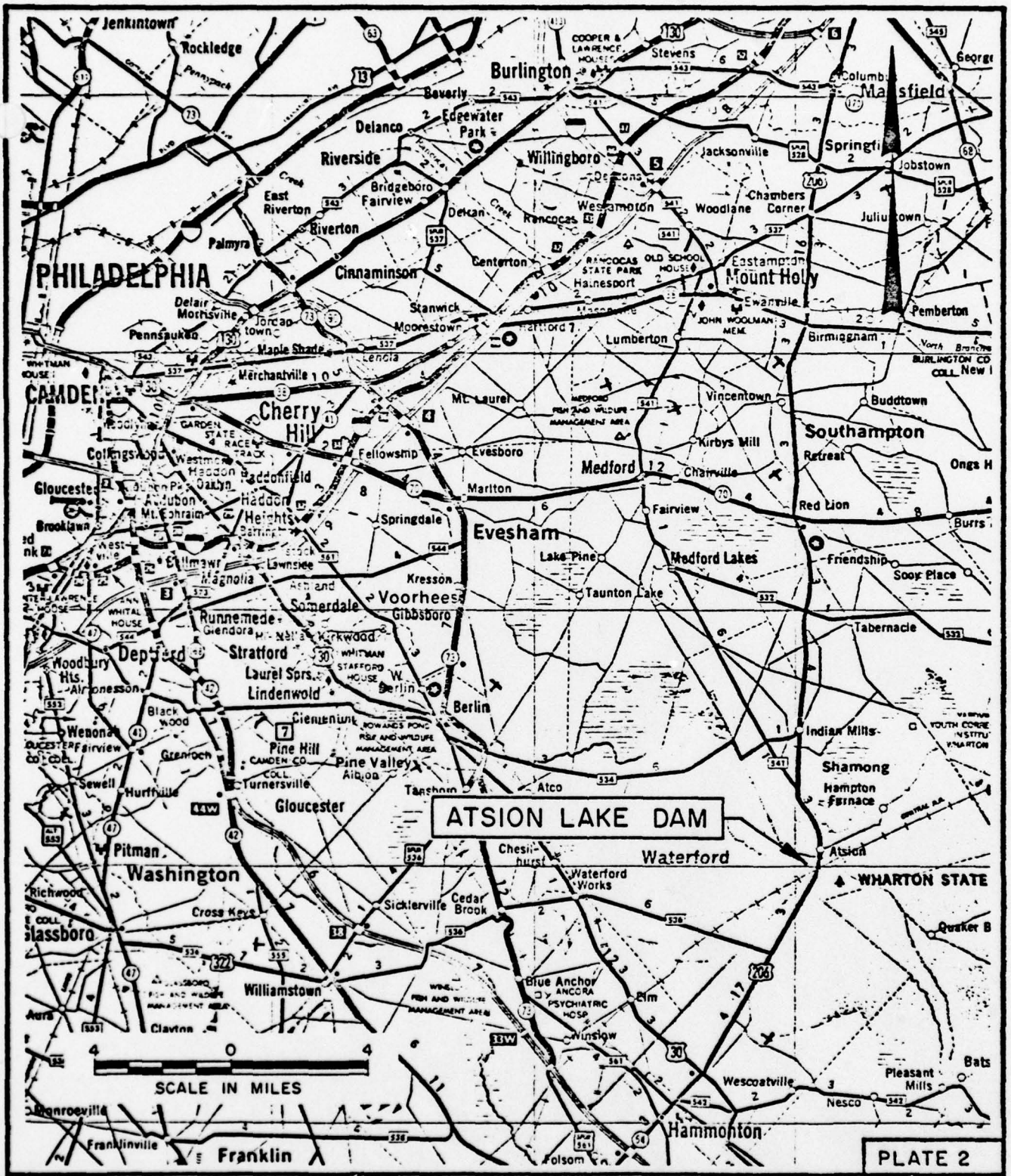


PLATE 2

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

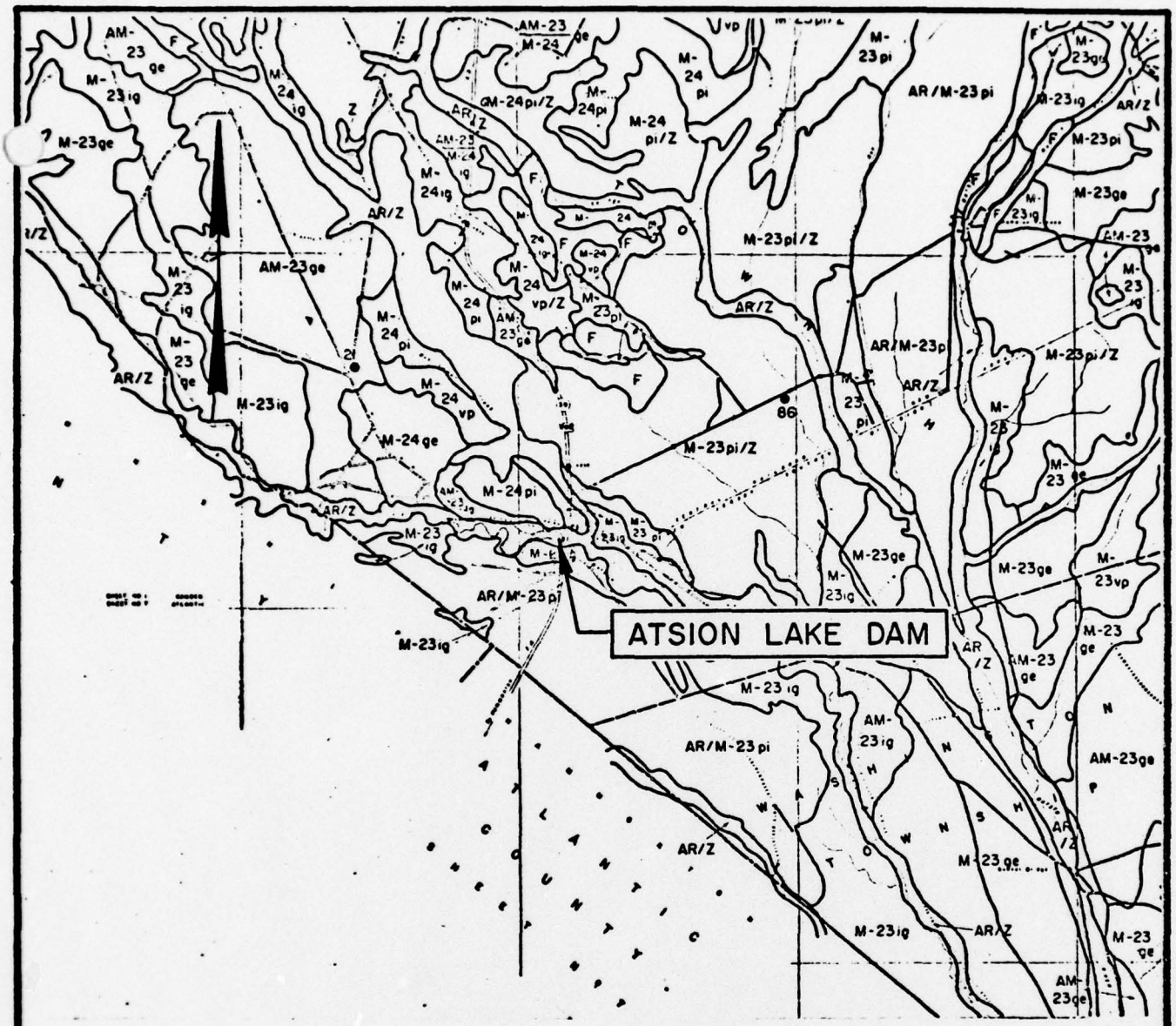
VICINITY MAP

ATSION LAKE DAM

I.D. N.J. 00041

SCALE: AS SHOWN

DATE: MARCH, 1979



Legend

AR/Z	Stratified, swampy alluvium.
M-23	Stratified materials, predominantly silty sand and narrowly graded sand, deposited during the Tertiary period. (Kirkwood Sand formations.)

Note Information taken from Rutgers University Soil Survey of New Jersey, Report No. 20 and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

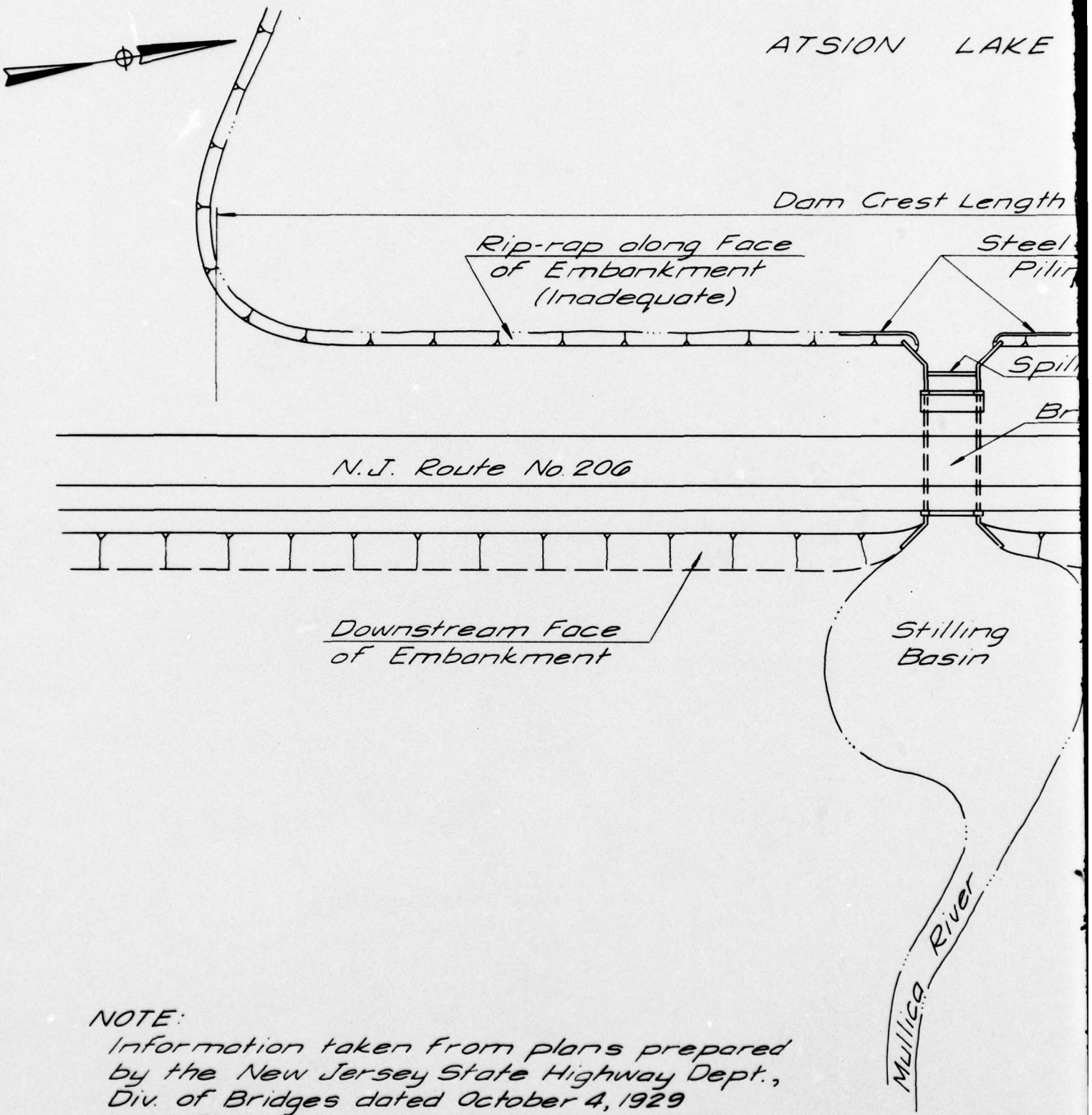
SOIL MAP

ATSION LAKE DAM

I.D. N.J. 00041

SCALE: NONE

DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by the New Jersey State Highway Dept., Div. of Bridges dated October 4, 1929 and field inspection December 12, 1978.

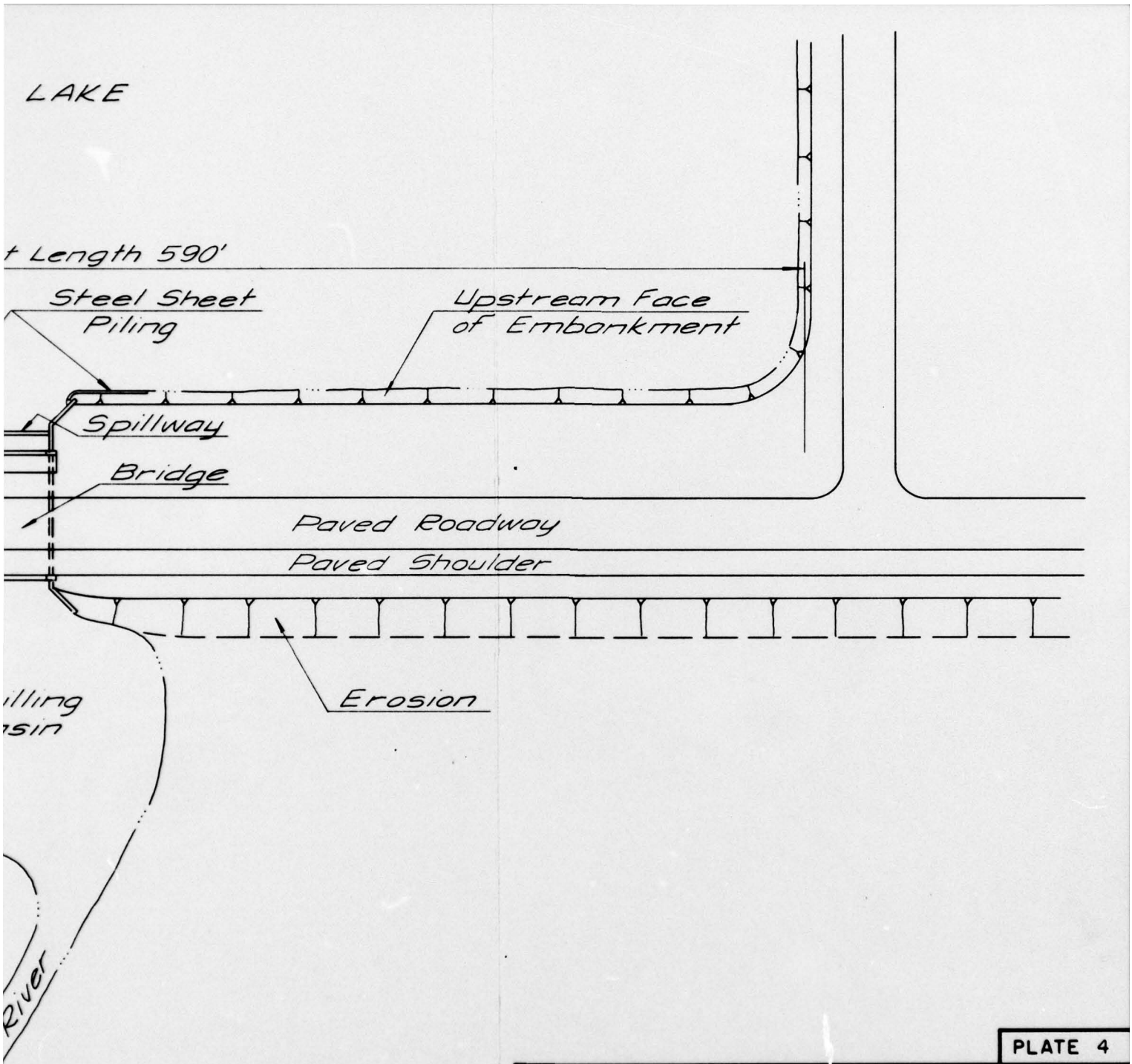


PLATE 4

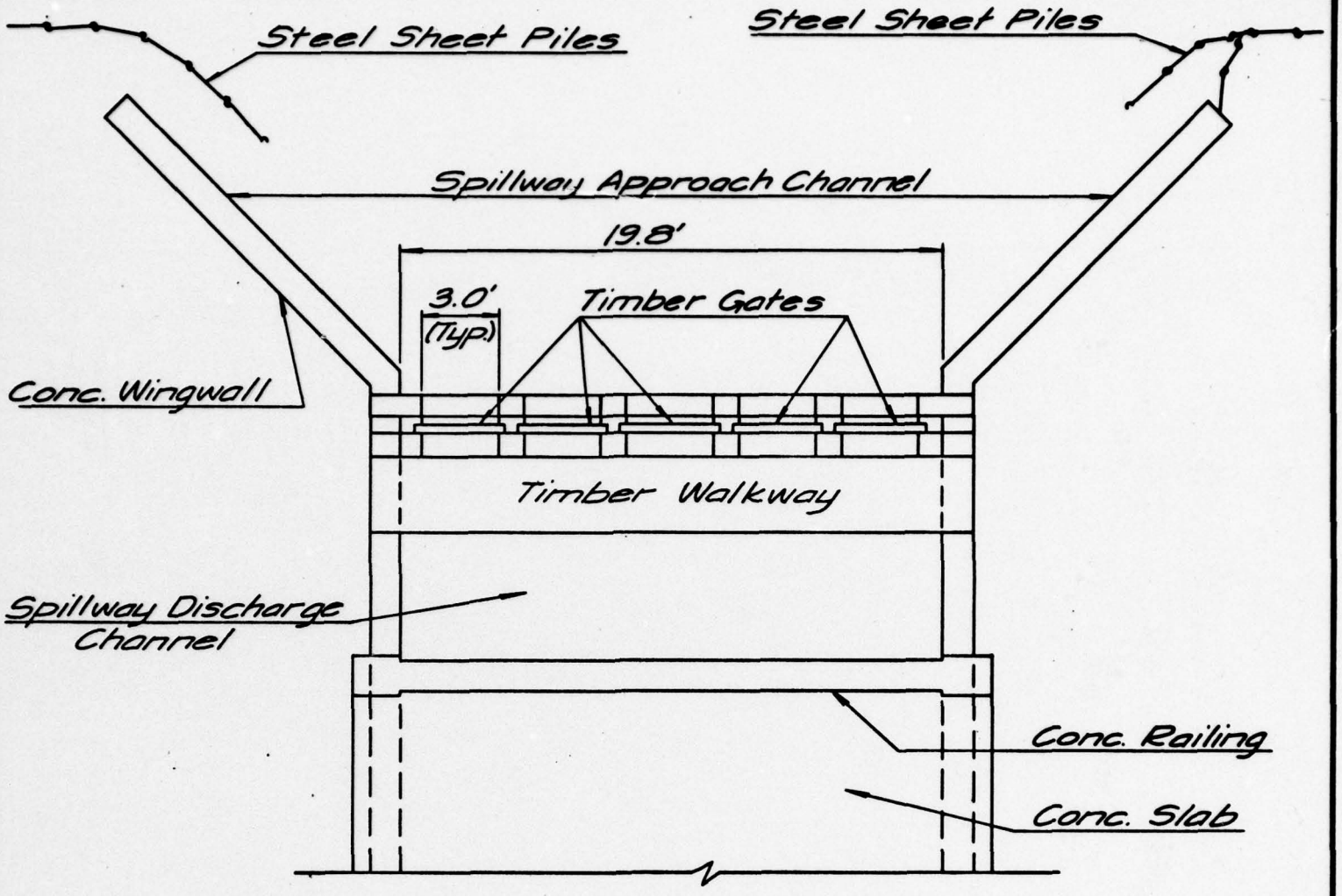
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN

ATSION LAKE DAM

I.D. N.J. 00041	SCALE: NOT TO SCALE
	DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by the New Jersey State Highway Dept., Div. of Bridges dated October 4, 1929 and field inspection December 12, 1978.

INSPECTION AND EVALUATION OF DAMS

SPILLWAY PLAN

ATSION LAKE DAM

I.D. N.J. 00041

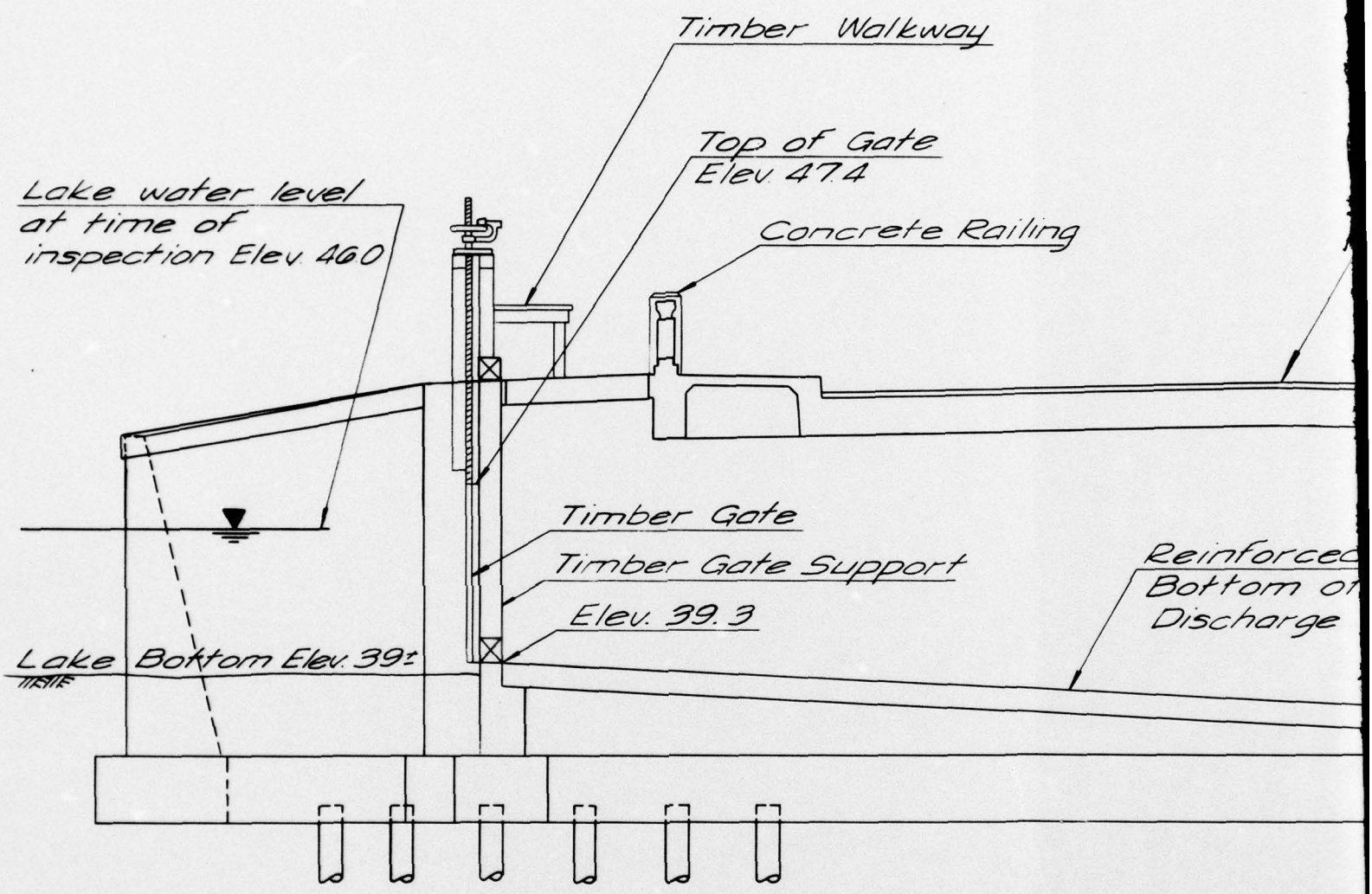
SCALE: NOT TO SCALE

DATE: MARCH, 1979

PLATE 5

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

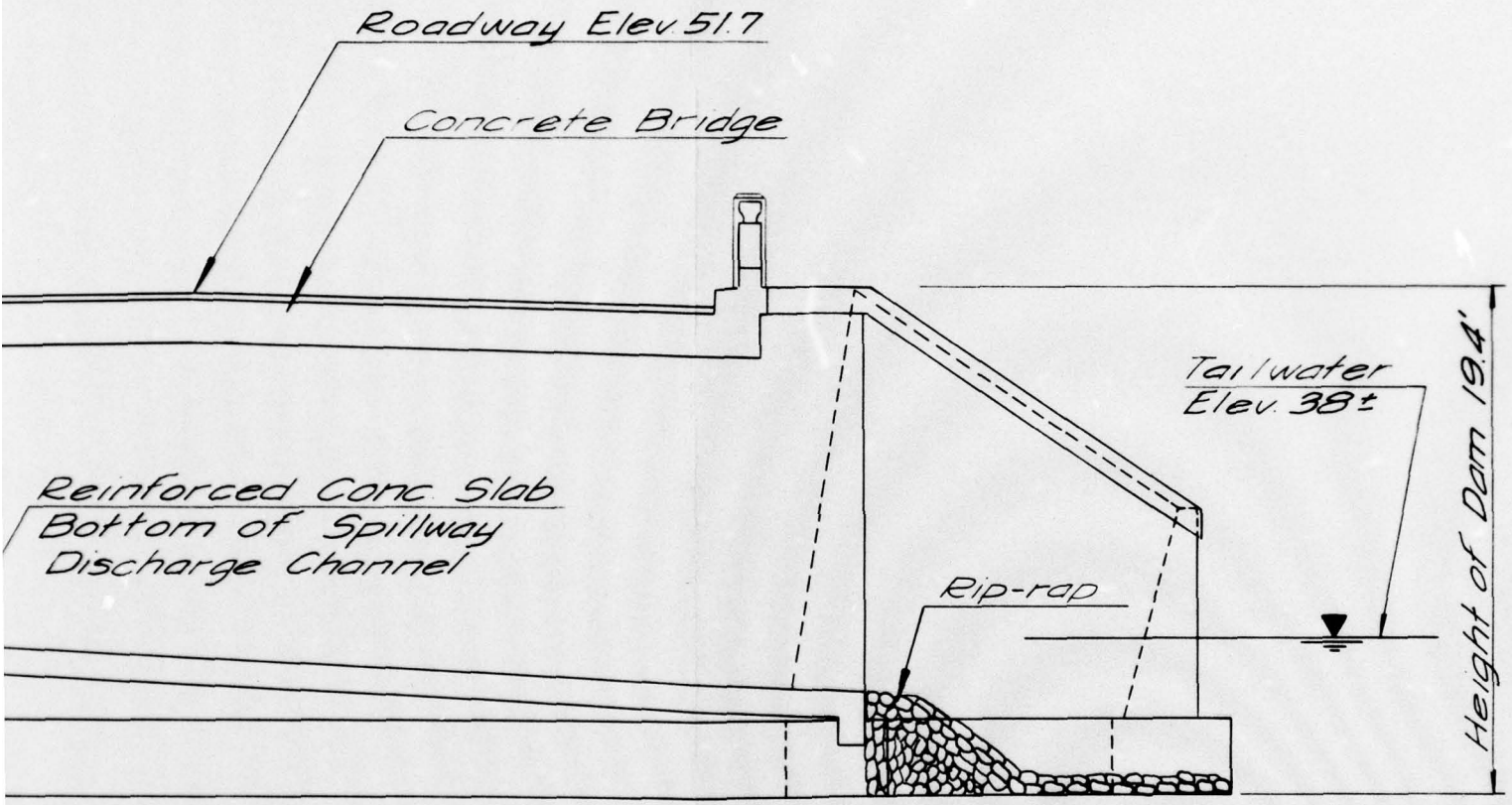
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY



Footings for upstream and downstream wingwalls and bridge abutments rest on three rows of piles with staggered spacing.

NOTE:
Information taken from plans prepared by the New Jersey State Highway Dept., Div. of Bridges dated October 4, 1929 and field inspection December 12, 1978.

1



unstream
rest on
gered

PLATE 6

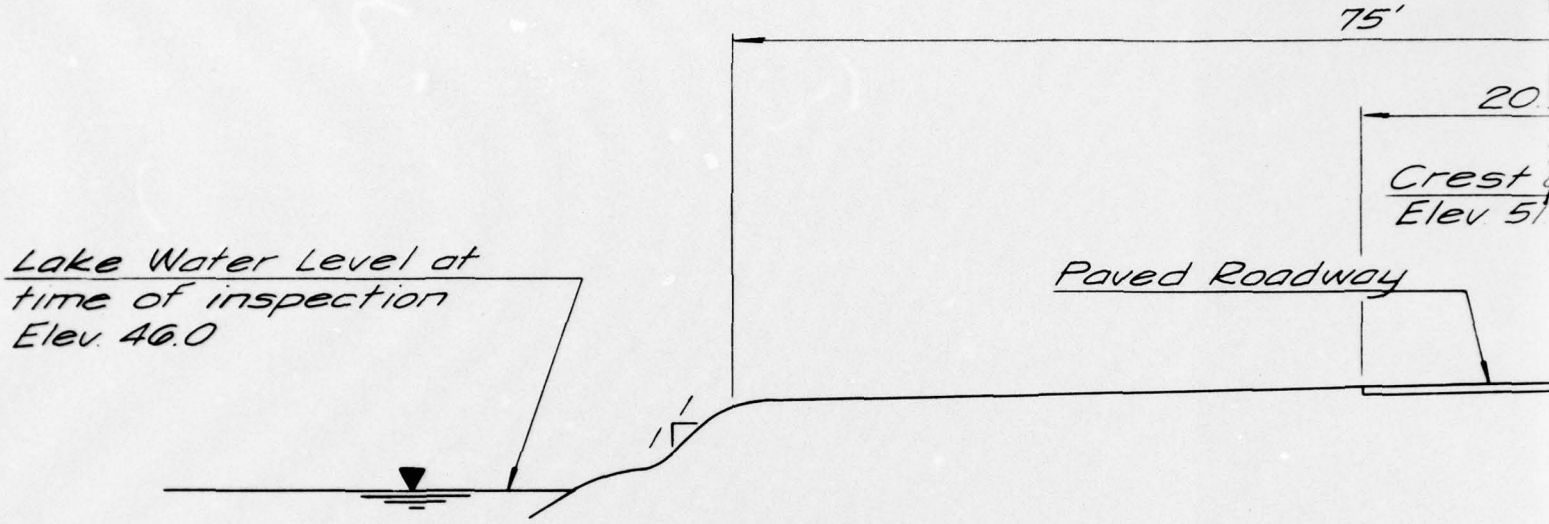
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

SPILLWAY SECTION

ATSION LAKE DAM

I.D. N.J. 00041	SCALE: NOT TO SCALE
	DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by the New Jersey State Highway Dept., Div. of Bridges dated October 4, 1929 and field inspection December 12, 1978.

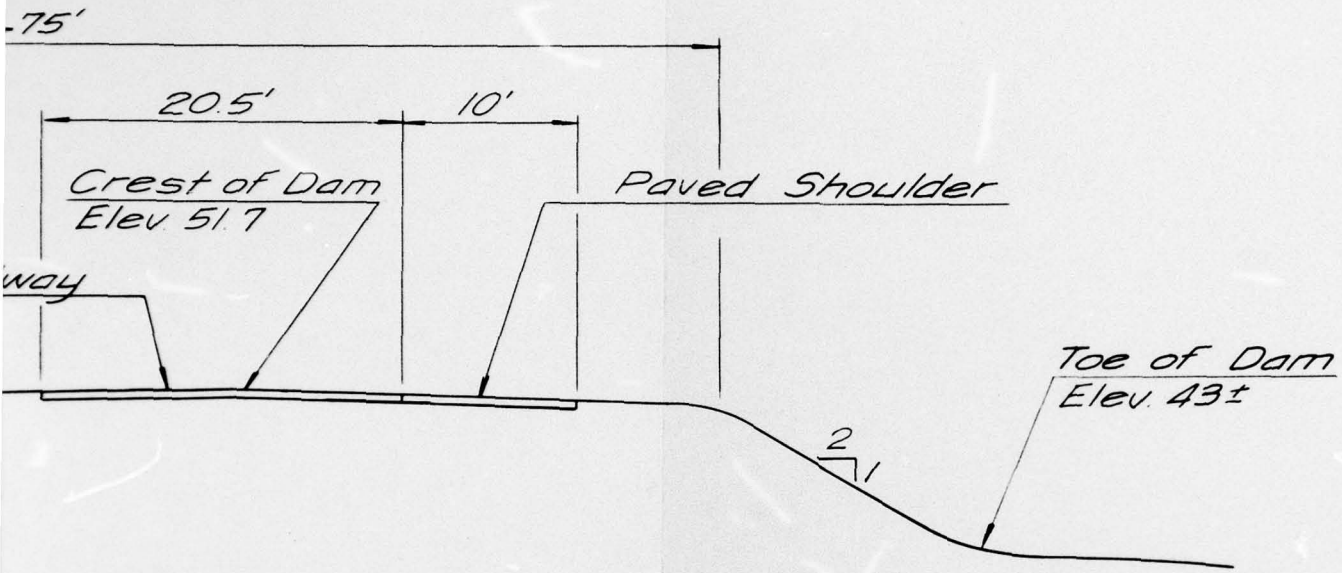


PLATE 7

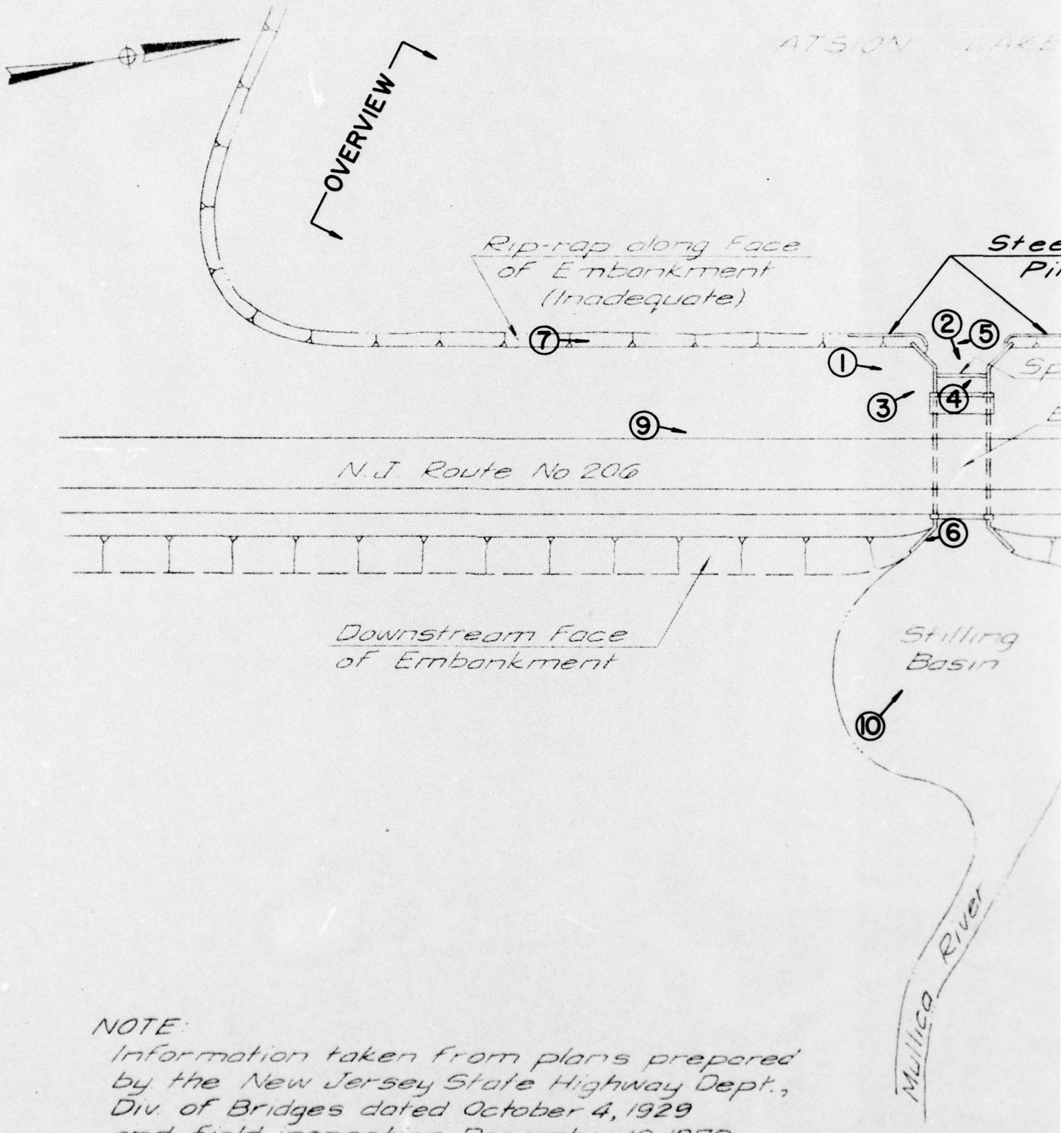
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

DAM SECTION

ATSION LAKE DAM

I.D. N.J. 00041	SCALE: NOT TO SCALE
	DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by the New Jersey State Highway Dept., Div. of Bridges dated October 4, 1929 and field inspection December 12, 1978.

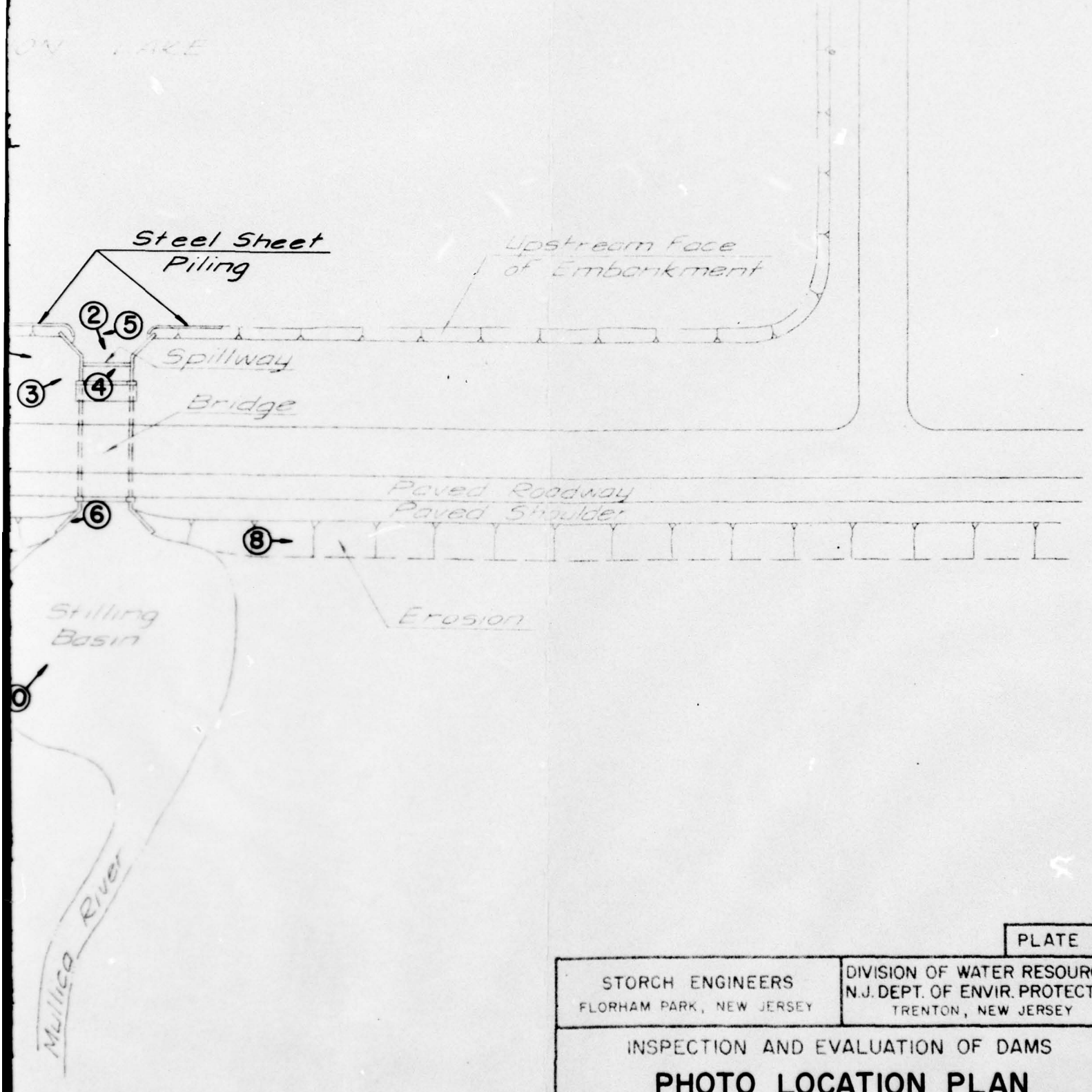


PLATE 8

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

ATSION LAKE DAM

I.D. N.J. 00041	SCALE: NOT TO SCALE
	DATE: MARCH, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase 1

Name Dam Atsion Lake **County** Burlington **State** N.J. **Coordinators** NJDEP

Date(s) Inspection 12/12/78 2/28/79 **Weather** Partly-Cloudy **Temperature** 42°F

Pool Elevation at Time of Inspection 46.0 **M.S.L.** **Tailwater at Time of Inspection** 39.8 **M.S.L.**

Inspection Personnel:

Richard McDermott — Edward Wiltsie

John Gribbin

Dinesh Patel

J.Gribbin **Recorder**

Present: Sydney Walker, Regional Supervisor, Wharton State Forest

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	N.A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N.A.	
DRAINS	N.A.	
WATER PASSAGES	N.A.	
FOUNDATION	N.A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N.A.	
STRUCTURAL CRACKING	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N.A.	
MONOLITH JOINTS	N.A.	
CONSTRUCTION JOINTS	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion on upstream face. Significant erosion on downstream face.	Section of downstream face had been covered with bit. pavement which is now partially broken away by the erosion.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Vert. - Level south of spillway. At north end, crest approx. 1 foot lower than elev. at spillway. Horiz. - Straight	
RIPRAP FAILURES	Riprap along upstream face of embankment in poor condition.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Paved highway runs along crest. Embankment slopes grass covered with thick tree cover on downstream face and a few trees on upstream face.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition	
ANY NOTICEABLE SEEPAGE	None	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Significant concrete cracking and spalling. See Bridge and Piers.	
INTAKE STRUCTURE	Same as outlet structure.	
OUTLET STRUCTURE	Timber gates leaking around edges and through some joints between boards. Timber structure supporting gates in good condition.	Five timber gates that constitute spillway can also serve as outlet works.
OUTLET CHANNEL	Water outflows through dam facility between concrete bridge abutments. Same as spillway discharge channel.	
EMERGENCY GATE	Timber gates same as Outlet Structure.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	N.A.	
BRIDGE AND PIERS	N.A.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	No obstructions	Straight channel through dam formed by concrete bridge abutments. Same as Outlet Channel.
BRIDGE AND PIERS	Concrete bridge spanning discharge channel. Appears to be structurally sound. Concrete in abutment and wingwalls significantly cracked and spalled.	
GATES AND OPERATION EQUIPMENT	See Outlet Works.	Gates serve as both spillway and outlet works.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	N.A.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slope of lake shores generally flat; less than 1%.	
SEDIMENTATION	Not known.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No significant obstructions. Large stilling basin downstream of dam.	
SLOPES	Slopes are generally flat. Wide flood plain.	
APPROXIMATE NO. OF HOMES AND POPULATION	3 inhabitable buildings within 1000' of dam. No additional buildings within approx. 8 miles.	Population: 1 building reportedly inhabited; 1 building used as hunting lodge; 1 building used as summer cabin.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available (NJDEP File)
TYPICAL SECTIONS OF DAM	Not Available
HYDROLOGIC/HYDRAULIC DATA	Available (NJDEP File)
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	Available (NJDEP File)
RAINFALL/RESERVOIR RECORDS	Not available

ITEM	REMARKS
DESIGN REPORTS	Available for hydraulic/hydrologic design (NJDEP File) Not available for structural design
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS	
HYDROLOGY & HYDRAULICS	Available (NJDEP File)
DAM STABILITY	Not available
SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Not available

ITEM	REMARKS
MONITORING SYSTEMS	Not available
MODIFICATIONS	Not available
HIGH POOL RECORDS	Gaging records downstream only (NJDEP File)
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Limited reports available (NJDOT File)
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Available (NJDEP File)
MAINTENANCE OPERATION RECORDS	Not available

ITEM	REMARKS
SPILLWAY PLAN	Available: New Jersey State Highway Dept., Div. of Bridges drawing for bridge at "Route No. 39, Sect. 8, Sta. 2693 + 64" not dated.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not available

APPENDIX 2

Photographs

PHOTO 1

SPILLWAY APPROACH CHANNEL.
RUSTED STEEL SHEET PILING.

PHOTO 2

SPILLWAY GATE STRUCTURE

12 DEC. 1978

PHOTO 3

GATE OPERATING MECHANISM AND
TIMBER WALKWAY

PHOTO 4

TIMBER GATES WITH LEAKING AROUND
EDGES AND THROUGH SEAMS

12 DEC. 1978

PHOTO 5

UPSTREAM FACE OF EMBANKMENT

PHOTO 6

BROKEN CONCRETE IN DOWNSTREAM
WINGWALL OF BRIDGE

12 DEC. 1978

PHOTO 7

RIPRAP ALONG UPSTREAM FACE OF EMBANKMENT

PHOTO 8

EROSION ON DOWNSTREAM FACE OF EMBANKMENT

12 DEC. 1978

PHOTO 9

PAVED ROAD ON CREST OF DAM

PHOTO 10

STILLING BASIN

12 DEC. 1978

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately Wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 48±(250 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 52.2

ELEVATION TOP DAM: Varies: 50.5 to 51.7

SPILLWAY CREST: Five slide gates

a. Elevation 47.4
b. Type Sharp crested weir
c. Width N.A.
d. Length 15 feet
e. Location Spillover Upstream side of dam
f. Number and Type of Gates Five slide gates

OUTLET WORKS: Five slide gates

a. Type Slide gates
b. Location same as spillway
c. Entrance inverts 40.3
d. Exit inverts same as entrance
e. Emergency draindown facilities: Raise slide gates

HYDROMETEOROLOGICAL GAGES: None

a. Type N.A.
b. Location N.A.
c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to elev. 50.2) 190 cfs

APPENDIX 4

Hydrologic Computations

STORCH ENGINEERS

Sheet 1 of 9

Project Atsion Lake Dam 1132

Made By RL Date 3-22-79

Chkd By JG Date

Size classification

Surface area of Impoundment	84.5 Ac.
Maximum storage	1050 Ac.-ft.
Structural height of dam	19.4 ft
Size classification	Intermediate

Hazard Potential Classification

Number of inhabitable structures	1 home, 1 hunting lodge and 1 summer cottage
Hazard potential classification	high
Recommended SDF	PMF

Hydrologic Analysis

The runoff hydrograph will be developed by HEC-1-DB using the Snyder's coefficients and routing by modified Puls method.

Drainage area = 27 sq. miles

Infiltration data

Mostly wooded area, use intial infiltration 1.5 in
hourly " 0.15 in

Unit Hydrograph Data

Length of watercourse L = 20.8 mi
(Measured along Mullica River)

Length of watercourse from Centroid of watershed to Pond L_{CA} = 11 mi

$L L_{CA} = 20.8 (11) = 228.8 \text{ mi}^2$

From Plate 17 Basin Lag Curves # 3
Memo 459 Corps of Engineers

$t_p = 31$ hrs

$C_p = 0.60$

Lake Storage Volume

EL (ft)	39.0	47.4	50.0
Surface Area (AC)	0	84.5	496.0

STORCH ENGINEERS

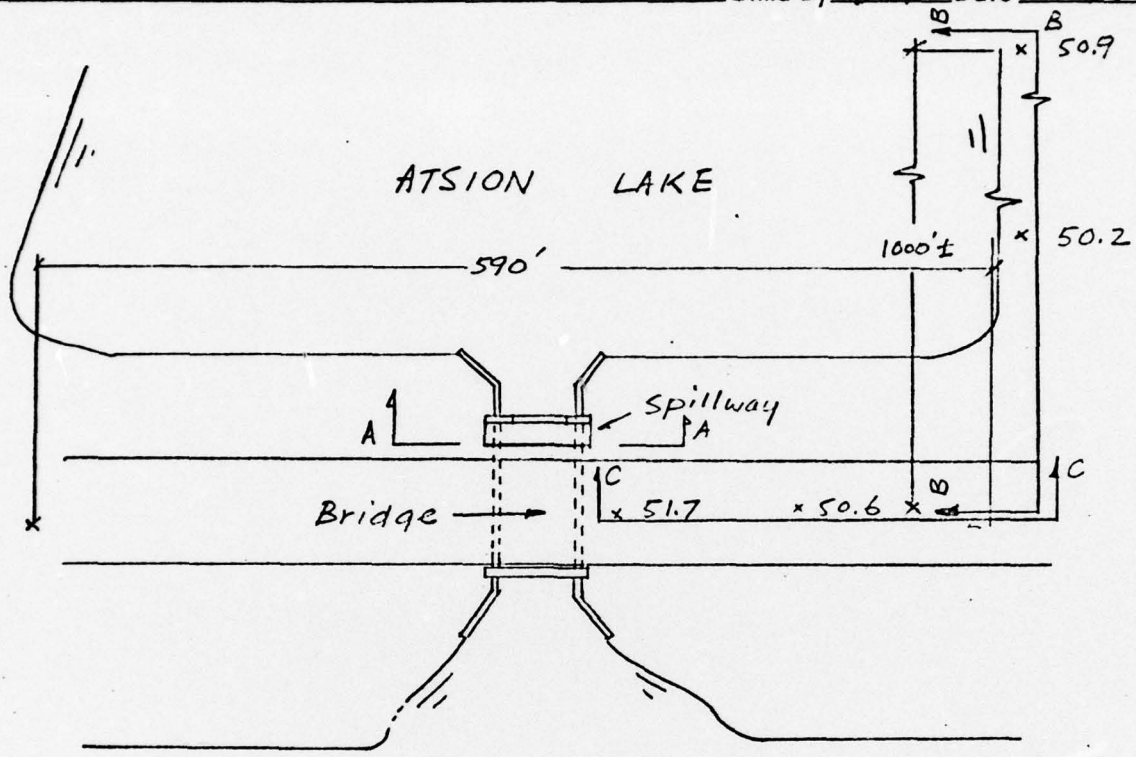
Sheet 3 of 9

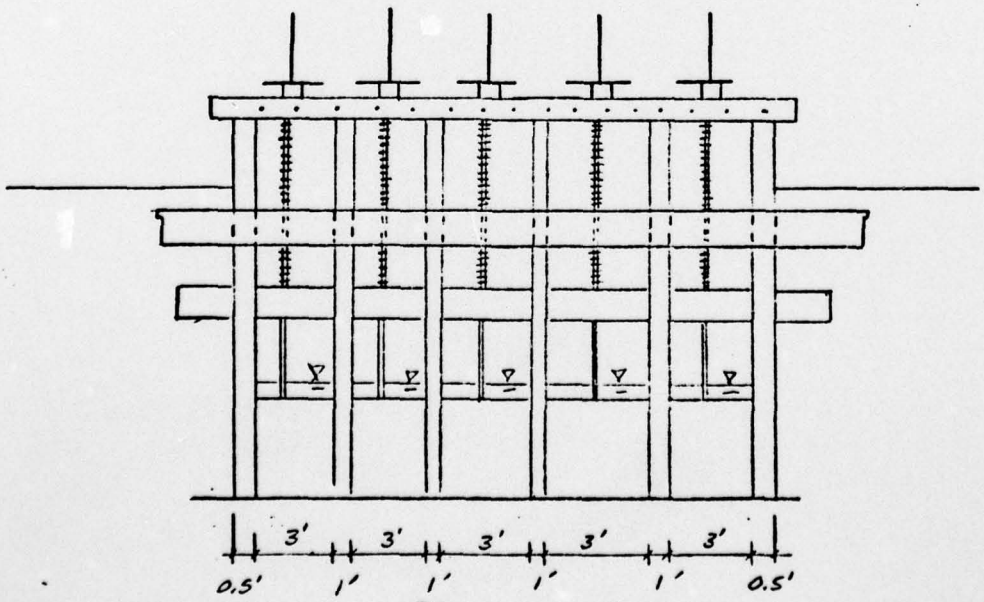
Project Atsion Lake Dam

Made By RL Date 3-22-79

1132

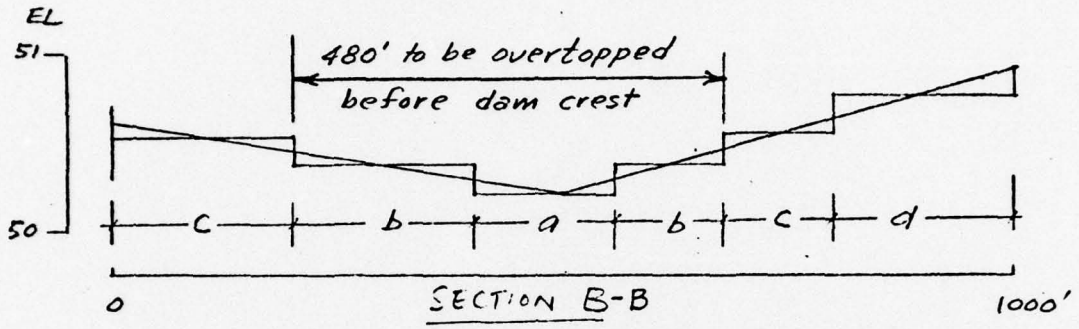
Chkd By DMP Date 3-23-79





SECTION A-A

Low area along north shore of lake adjacent to dam



SECTION B-B

V 1" = 1' H 1" = 200'

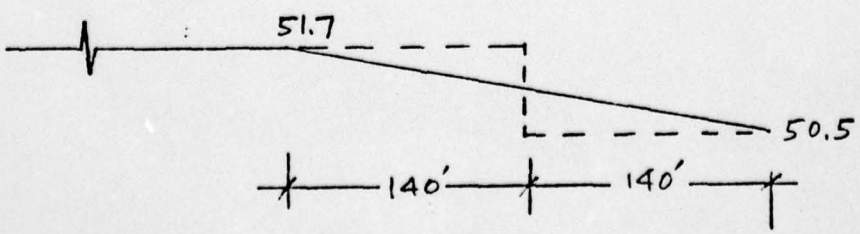
Level a = 160' @ EL. 50.2
b = 320' @ EL. 50.35
c = 460' * @ EL. 50.5
d = 200' @ EL. 50.75

Dam embankment is assumed to be level at EL 51.7 for 310' and drops down to EL. 50.5 in 280'. Stage discharge calculation over the dam and the low area will be:

$Q = CLh^{3/2}$

C = 2.63
L = Length at various levels
h = head over weir

* Includes 140' of main embankment. (See below)



SECTION C-C

Elevation - Discharge Calculation

Ref. " Pg 373 Design of Small Dam"

The following data are obtained with the assumption that all gates remain closed in a storm and that discharge over the gates is simulated by discharge over sharp-crested weir.

$$L = L' - 2(N K_p + K_a)H$$

Where L = effective length of crest
L' = net length of crest
N = number of piers
K_p = pier contraction coef
K_a = abutment contraction coef
H = total head over crest

$N = 4$
$L' = 15.0$
$K_a = 0.2$ $K_p = 0.02$

$$L = 15.0 - 2(4 \times 0.02 + 0.2)H$$
$$L = 15.0 - 0.56H$$

STAGE DISCHARGE TABULATION

W.L. (ft)	h_1 (ft)	h_2 (ft)	L_1 (ft)	L_2 (ft)	Q_1 (cfs)	Q_2 (cfs)	ΣQ (cfs)
47.4	0	0	-	-	-	0	0
47.9	0.5	0	14.7	0	16	0	16
48.4	1.0	0	14.4	0	44	0	44
48.9	1.5	0	14.2	0	79	0	79
49.4	2.0	0	13.9	0	119	0	119
49.9	2.5	0	13.6	0	162	0	162
50.2	2.8	0	13.5	0	190	0	190
50.4	3.0	0.2, 0.05, 0	13.3	a, b	209	47	256
50.9	3.5	0.7, 0.55, 0.4, 0.15	13.0	a, b, c, d	257	926	1213
51.4	4.0	1.2, 1.05, 0.9, 0.65	12.8	a, b, c, d	307	2767	3074
51.7	4.3	1.5, 1.35, 1.2, 0.95	12.6	a, b, c, d	337	4170	4507
51.9	4.5	1.7, 1.55, 1.4, 1.15	12.5	a, b, c, d	357	5210	5567
52.4	5.0	2.2, 2.05, 1.9, 1.65	12.2	a, b, c, d	408	8127	8535
52.9	5.5	2.7, 2.55, 2.4, 2.15	11.9	a, b, c, d	458	11450	11908

h_1 = head over gates

h_2 = head over embankment

STORCH ENGINEERS

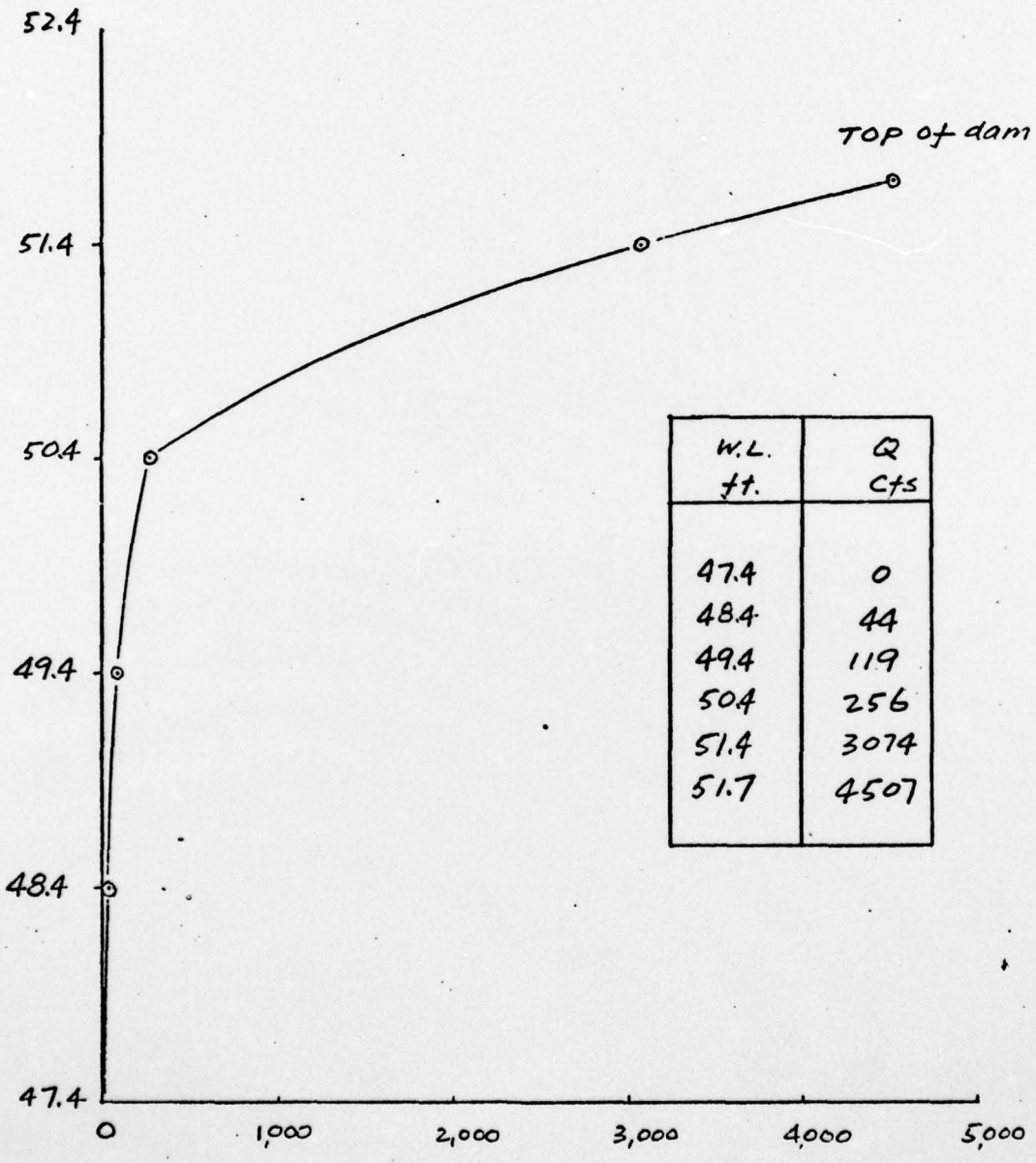
Sheet 7 of 9

Project Atsion Lake Dam 1132

Made By RL Date 3-23-79

Chkd By DMP Date 3-23-79

STAGE DISCHARGE CURVE



W.L. ft.	Q Cfs
47.4	0
48.4	44
49.4	119
50.4	256
51.4	3074
51.7	4507

Outlet works Capacity

Assume drawdown by openning 1 gates only.
Dimenion of openning

$2.77' \times 5' = 13.85$ Sq. ft.

Since water level is normally at 47.4 and bottom of gate at 39.0, this openning will operate as an orifice.

use $Q = CA\sqrt{2gh}$

$A = 13.85$ Sq ft.
$h = 2.5 + 3.4 = 5.9'$ (to center of openning)

$C = 0.6$

At W.L. 47.4, discharge

$$Q = 0.6 \times 13.85 \times \sqrt{64.4 \times 5.9}$$

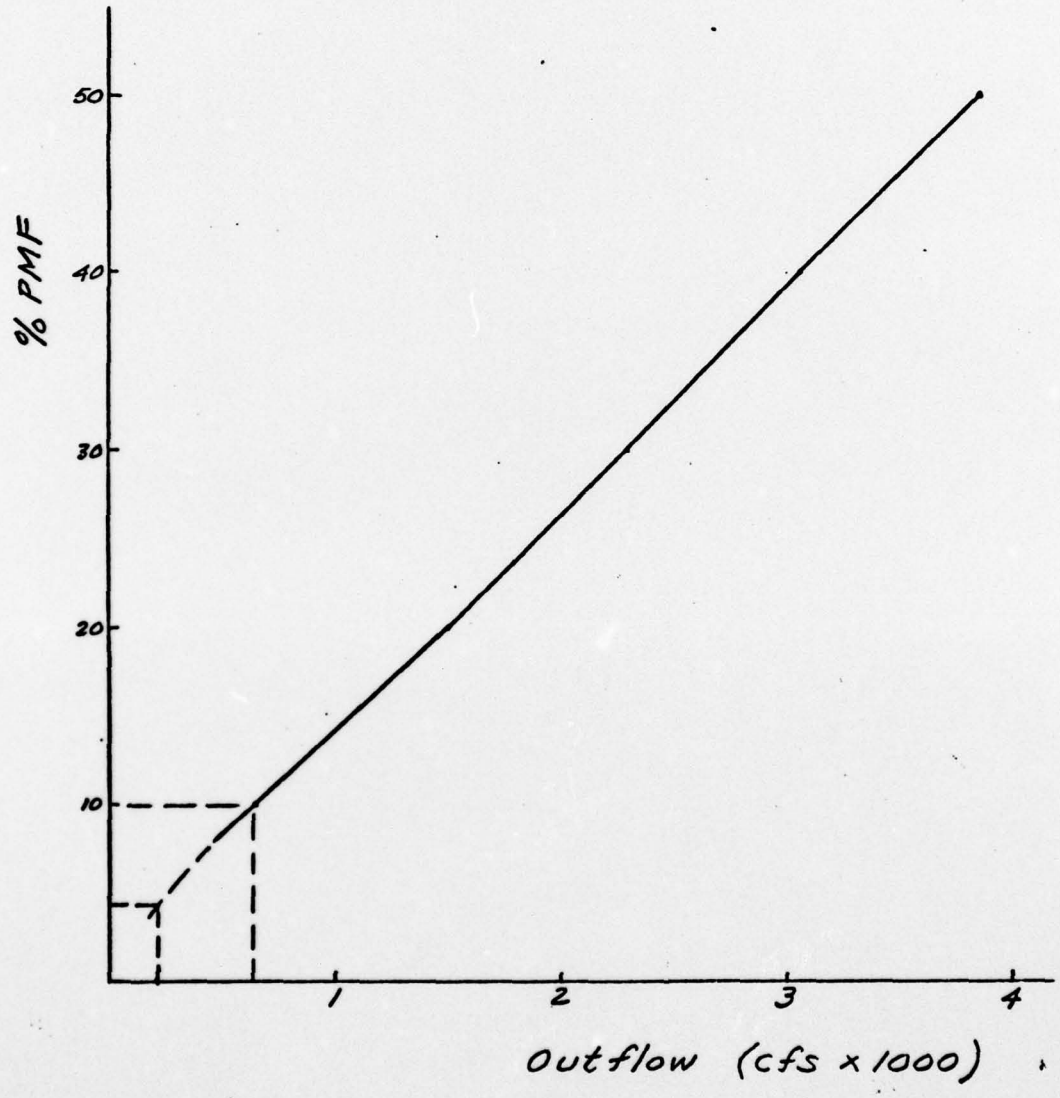
$$= \underline{162 \text{ cfs.}}$$

STORCH ENGINEERS Sheet 9 of 9

Project 1132 Made By JG Date 3-23-79

Atsion Lake Dam Chkd By _____ Date _____

OVERTOPPING POTENTIAL



Overtopping of low area occurs at elev. 50.2 with Q = 220 c.f.s. (~4 % PMF)

Overtopping of dam occurs at elev. 50.5 with Q = 445 c.f.s. (~10 % PMF)

HEC-1-DB COMPUTATIONS

```
A1                                NATIONAL DAM SAFETY PROGRAM
A2                          ATSION DAM, NEW JERSEY
A3                                PMF STORM ROUTING
B     150         1         0                                   0         0         3
B1      5
J       1         5         1
J1    0.5       0.4       0.3       0.2       0.1
K       0     ATSION                    0         0         1
K1                          INFLOW HYDROGRAPH TO ATSION DAM
M       1         1        27                  27                                    1
P       0        27       100       109       117
T                                                                 1.5      0.15
W      31       0.6
X    -1.0     -0.05       2.0
K       1       DAM                   0         0         1
K1                          ROUTE DISCHARGE THRU ATSION DAM
Y                                     1         1
Y1      1                                                  -47.4        -1
Y4   47.4      47.9      48.4      48.9      49.4      49.9      50.4      50.9      51.4      51.9
Y4   52.4      52.9
Y5      0        16        44        75       119       162       256      1213      3074      5567
Y5   8535     11908
$A      0      84.5       496
$E     39        48        50
$$   47.4
$D   51.7      2.63       1.5       450
K      99
A
A
A
A
A
```

Form 14852

J.T.C. Computer Forms Div.

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A1                                NATIONAL DAM SAFETY PROGRAM
A2                          ATSION DAM, NEW JERSEY
A3                                PMF STORM ROUTING
3     150         1         0                                   0         0         3
31      5
J       1         1         1
J1      1
K       0  ATSION                          0         0         1
K1                          INFLOW HYDROGRAPH TO ATSION DAM
M       1         1        27        27                                            1
P       0        27       100       109       117
T                                                             1.5      0.15
W      31       0.6
X    -1.0     -1.05       2.0
K       1       DAM                        0         0         1
K1                          ROUTE DISCHARGE THRU ATSION DAM
Y                                        1         1
Y1      1                                                   -47.4        -1
Y4   47.4      47.9      48.4      48.9      49.4      49.9      50.4      50.9      51.4      51.9
Y4   52.4      52.9
Y5      0        16        44        79       119       162       256      1213      3074      5567
Y5   8535     11308
$A      0      84.5       496
$E     39        48        50
$$   47.4
$D   51.7      2.63       1.5       450
K      99
A
A
A
A
A
```

NATIONAL DAM SAFETY PROGRAM
ATSION DAM, NEW JERSEY
PME STORM ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	1	0	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO ATSION DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ATSION	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	27.00	0.00	27.00	0.00	0.000	0	1	0

PRECIP DATA

	SPFE	PMS	R6	R12	R24	R48	R72	R96
TRSPC COMPUTED	0.00	27.00	100.00	109.00	117.00	0.00	0.00	0.00
BY THE PROGRAM IS .832								

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 31.00 CP= .60 NTA= 0

APPROXIMATE RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00
CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=32.96 AND R=30.89 INTERVALS

UNIT HYDROGRAPH DATA
TP= 31.00 CP= .60 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=32.96 AND R=30.89 INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 30.90 HOURS, CP= .60 VOL= .93

	8.	16.	27.	38.	51.	64.	79.	94.	109.
126.	142.	159.	177.	194.	212.	230.	248.	264.	279.
292.	304.	315.	325.	333.	340.	346.	350.	352.	353.
352.	350.	345.	336.	325.	315.	305.	295.	286.	276.
265.	259.	251.	243.	235.	228.	220.	213.	207.	200.
194.	187.	181.	176.	170.	165.	159.	154.	149.	145.
140.	136.	131.	127.	123.	119.	115.	112.	108.	105.
102.	98.	95.	92.	89.	86.	83.	81.	78.	76.
74.	71.	69.	67.	64.	62.	60.	58.	57.	55.
53.	51.	50.	48.	47.	45.	44.	42.	41.	40.

AD-A069 592 HONEYWELL INC MINNEAPOLIS MN CORPORATE COMPUTER SCIE--ETC F/G 13/2
NATIONAL DAM SAFETY PROGRAM. ATSION LAKE DAM (NJ 00041), ATLANT--ETC(U)
MAY 79 R J MCDERMOTT DACW61-78-C-0124

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2 OF 2
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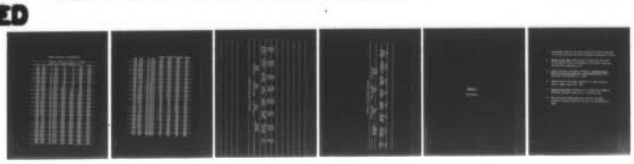

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PMF OUTFLOW HYDROGRAPH

STATION DAM, PLAN 1, RATIO 1 (PMF)

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	1.00	1	1.00	25.	1.	208.	47.4
1.01	2.00	2	2.00	24.	2.	210.	47.5
1.01	3.00	3	3.00	22.	2.	212.	47.5
1.01	4.00	4	4.00	20.	3.	213.	47.5
1.01	5.00	5	5.00	19.	4.	214.	47.5
1.01	6.00	6	6.00	18.	4.	215.	47.5
1.01	7.00	7	7.00	17.	4.	216.	47.5
1.01	8.00	8	8.00	16.	5.	217.	47.5
1.01	9.00	9	9.00	15.	5.	218.	47.6
1.01	10.00	10	10.00	15.	5.	219.	47.6
1.01	11.00	11	11.00	17.	6.	220.	47.6
1.01	12.00	12	12.00	20.	6.	221.	47.6
1.01	13.00	13	13.00	30.	7.	222.	47.6
1.01	14.00	14	14.00	54.	8.	225.	47.6
1.01	15.00	15	15.00	100.	10.	230.	47.7
1.01	16.00	16	16.00	188.	14.	241.	47.9
1.01	17.00	17	17.00	329.	24.	261.	48.1
1.01	18.00	18	18.00	520.	42.	293.	48.4
1.01	19.00	19	19.00	755.	73.	341.	48.7
1.01	20.00	20	20.00	1016.	86.	408.	49.0
1.01	21.00	21	21.00	1304.	111.	496.	49.3
1.01	22.00	22	22.00	1612.	137.	606.	49.6
1.01	23.00	23	23.00	1938.	167.	740.	49.9
1.02	0.00	24	24.00	2279.	224.	899.	50.2
1.02	1.00	25	25.00	2632.	475.	1073.	50.5
1.02	2.00	26	26.00	2997.	950.	1246.	50.8
1.02	3.00	27	27.00	3371.	1478.	1409.	51.0
1.02	4.00	28	28.00	3753.	2116.	1555.	51.1
1.02	5.00	29	29.00	4142.	2694.	1685.	51.3
1.02	6.00	30	30.00	4533.	3120.	1805.	51.4
1.02	7.00	31	31.00	4924.	3663.	1916.	51.5
1.02	8.00	32	32.00	5309.	4138.	2016.	51.6
1.02	9.00	33	33.00	5679.	4567.	2110.	51.7
1.02	10.00	34	34.00	6026.	4935.	2199.	51.8
1.02	11.00	35	35.00	6345.	5302.	2282.	51.8
1.02	12.00	36	36.00	6634.	5759.	2358.	51.9
1.02	13.00	37	37.00	6895.	6135.	2426.	52.0
1.02	14.00	38	38.00	7126.	6461.	2485.	52.0
1.02	15.00	39	39.00	7327.	6745.	2535.	52.1
1.02	16.00	40	40.00	7498.	6985.	2580.	52.1
1.02	17.00	41	41.00	7639.	7195.	2619.	52.1
1.02	18.00	42	42.00	7748.	7373.	2652.	52.1
1.02	19.00	43	43.00	7824.	7520.	2679.	52.2
1.02	20.00	44	44.00	7854.	7635.	2700.	52.2
1.02	21.00	45	45.00	7865.	7716.	2716.	52.2
1.02	22.00	46	46.00	7823.	7751.	2724.	52.2
1.02	23.00	47	47.00	7733.	7747.	2725.	52.2
1.03	0.00	48	48.00	7594.	7731.	2718.	52.2
1.03	1.00	49	49.00	7408.	7649.	2703.	52.2
1.03	2.00	50	50.00	7194.	7526.	2680.	52.2
1.03	3.00	51	51.00	6971.	7358.	2651.	52.1
1.03	4.00	52	52.00	6750.	7187.	2617.	52.1
1.03	5.00	53	53.00	6536.	6993.	2582.	52.1
1.03	6.00	54	54.00	6329.	6792.	2545.	52.1
1.03	7.00	55	55.00	6128.	6589.	2508.	52.0
1.03	8.00	56	56.00	5933.	6387.	2471.	52.0
1.03	9.00	57	57.00	5744.	6188.	2435.	52.0
1.03	10.00	58	58.00	5561.	5993.	2400.	51.9
1.03	11.00	59	59.00	5383.	5803.	2366.	51.9
1.03	12.00	60	60.00	5212.	5626.	2333.	51.9
1.03	13.00	61	61.00	5046.	5457.	2300.	51.9
1.03	14.00	62	62.00	4885.	5297.	2267.	51.8
1.03	15.00	63	63.00	4729.	5147.	2233.	51.8
1.03	16.00	64	64.00	4579.	4991.	2201.	51.8
1.03	17.00	65	65.00	4433.	4837.	2168.	51.8
1.03	18.00	66	66.00	4292.	4688.	2137.	51.7
1.03	19.00	67	67.00	4155.	4545.	2106.	51.7
1.03	20.00	68	68.00	4022.	4408.	2075.	51.7
1.03	21.00	69	69.00	3894.	4271.	2045.	51.6
1.03	22.00	70	70.00	3770.	4136.	2016.	51.6
1.03	23.00	71	71.00	3650.	4004.	1987.	51.6
1.04	0.00	72	72.00	3534.	3875.	1960.	51.6
1.04	1.00	73	73.00	3421.	3749.	1934.	51.5
1.04	2.00	74	74.00	3312.	3627.	1908.	51.5
1.04	3.00	75	75.00	3207.	3509.	1884.	51.5

				INFLOW	OUTFLOW	STORAGE	STAGE
1.04	4.00	76	76.00	3104.	3394.	1860.	51.5
1.04	5.00	77	77.00	3005.	3283.	1838.	51.4
1.04	6.00	78	78.00	2910.	3176.	1816.	51.4
1.04	7.00	79	79.00	2817.	3073.	1796.	51.4
1.04	8.00	80	80.00	2727.	2995.	1775.	51.4
1.04	9.00	81	81.00	2640.	2915.	1754.	51.4
1.04	10.00	82	82.00	2555.	2832.	1733.	51.3
1.04	11.00	83	83.00	2475.	2749.	1711.	51.3
1.04	12.00	84	84.00	2395.	2665.	1690.	51.3
1.04	13.00	85	85.00	2320.	2583.	1669.	51.3
1.04	14.00	86	86.00	2246.	2501.	1649.	51.2
1.04	15.00	87	87.00	2174.	2422.	1629.	51.2
1.04	16.00	88	88.00	2105.	2344.	1610.	51.2
1.04	17.00	89	89.00	2038.	2268.	1592.	51.2
1.04	18.00	90	90.00	1973.	2195.	1574.	51.2
1.04	19.00	91	91.00	1910.	2123.	1557.	51.1
1.04	20.00	92	92.00	1849.	2054.	1540.	51.1
1.04	21.00	93	93.00	1790.	1987.	1525.	51.1
1.04	22.00	94	94.00	1733.	1922.	1510.	51.1
1.04	23.00	95	95.00	1678.	1859.	1495.	51.1
1.05	0.00	96	96.00	1624.	1799.	1481.	51.1
1.05	1.00	97	97.00	1573.	1740.	1468.	51.0
1.05	2.00	98	98.00	1523.	1683.	1455.	51.0
1.05	3.00	99	99.00	1474.	1628.	1442.	51.0
1.05	4.00	100	100.00	1427.	1575.	1431.	51.0
1.05	5.00	101	101.00	1382.	1524.	1419.	51.0
1.05	6.00	102	102.00	1338.	1474.	1408.	51.0
1.05	7.00	103	103.00	1295.	1426.	1398.	51.0
1.05	8.00	104	104.00	1254.	1380.	1388.	50.9
1.05	9.00	105	105.00	1214.	1335.	1378.	50.9
1.05	10.00	106	106.00	1175.	1291.	1369.	50.9
1.05	11.00	107	107.00	1138.	1249.	1360.	50.9
1.05	12.00	108	108.00	1101.	1211.	1351.	50.9
1.05	13.00	109	109.00	1051.	1189.	1342.	50.9
1.05	14.00	110	110.00	1020.	1164.	1331.	50.9
1.05	15.00	111	111.00	981.	1136.	1320.	50.9
1.05	16.00	112	112.00	942.	1106.	1308.	50.8
1.05	17.00	113	113.00	832.	1069.	1293.	50.8
1.05	18.00	114	114.00	708.	1011.	1270.	50.8
1.05	19.00	115	115.00	562.	939.	1242.	50.8
1.05	20.00	116	116.00	380.	848.	1207.	50.7
1.05	21.00	117	117.00	355.	752.	1171.	50.7
1.05	22.00	118	118.00	331.	669.	1141.	50.6
1.05	23.00	119	119.00	309.	597.	1115.	50.6
1.06	0.00	120	120.00	288.	534.	1093.	50.5
1.06	1.00	121	121.00	269.	479.	1074.	50.5
1.06	2.00	122	122.00	251.	435.	1059.	50.5
1.06	3.00	123	123.00	234.	395.	1046.	50.5
1.06	4.00	124	124.00	218.	360.	1034.	50.5
1.06	5.00	125	125.00	204.	329.	1024.	50.4
1.06	6.00	126	126.00	190.	301.	1014.	50.4
1.06	7.00	127	127.00	177.	275.	1006.	50.4
1.06	8.00	128	128.00	165.	256.	999.	50.4
1.06	9.00	129	129.00	154.	254.	992.	50.4
1.06	10.00	130	130.00	144.	251.	984.	50.4
1.06	11.00	131	131.00	134.	249.	976.	50.4
1.06	12.00	132	132.00	125.	246.	967.	50.3
1.06	13.00	133	133.00	117.	243.	958.	50.3
1.06	14.00	134	134.00	109.	240.	949.	50.3
1.06	15.00	135	135.00	102.	237.	939.	50.3
1.06	16.00	136	136.00	95.	234.	928.	50.3
1.06	17.00	137	137.00	89.	230.	918.	50.3
1.06	18.00	138	138.00	83.	227.	907.	50.2
1.06	19.00	139	139.00	77.	223.	896.	50.2
1.06	20.00	140	140.00	72.	220.	885.	50.2
1.06	21.00	141	141.00	67.	216.	874.	50.2
1.06	22.00	142	142.00	63.	212.	863.	50.2
1.06	23.00	143	143.00	58.	208.	852.	50.1
1.07	0.00	144	144.00	55.	204.	841.	50.1
1.07	1.00	145	145.00	51.	200.	830.	50.1
1.07	2.00	146	146.00	47.	196.	819.	50.1
1.07	3.00	147	147.00	44.	192.	806.	50.1
1.07	4.00	148	149.00	41.	187.	794.	50.0
1.07	5.00	149	149.00	39.	183.	782.	50.0
1.07	6.00	150	150.00	36.	178.	770.	50.0

SUMMARY OF DAM SAFETY ANALYSIS

1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	47.40	47.40	51.70
STORAGE	206.	206.	2111.
OUTFLOW	0.	0.	4570.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	51.56	0.00	1958.	3867.	0.00	47.00	0.00
.40	51.40	0.00	1794.	3065.	0.00	47.00	0.00
.30	51.19	0.00	1600.	2302.	0.00	47.00	0.00
.20	50.98	0.00	1417.	1513.	0.00	48.00	0.00
.10	50.61	0.00	1136.	656.	0.00	53.00	0.00

SUMMARY OF DAM SAFETY ANALYSIS

•••••••••		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	47.40	47.40	51.70
	STORAGE	206.	206.	2111.
	OUTFLOW	0.	0.	4570.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	52.20	.50	2725.	7767.	33.00	47.00	0.00

APPENDIX 5

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